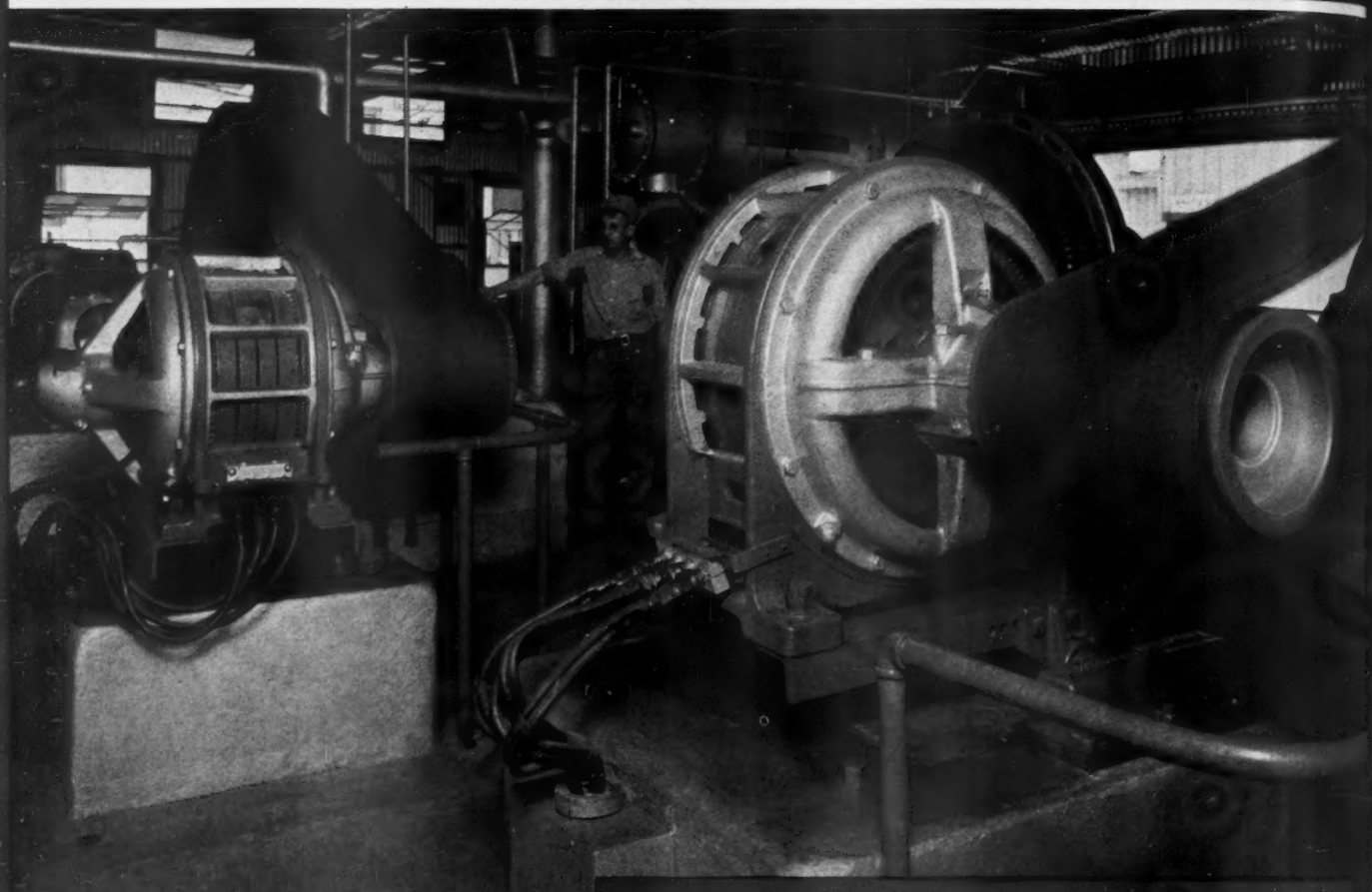
# Compressed Air Magazine

Vol. 42, No. 9 London - New York - Paris September, 1937

DELAWARE WATER GAP, PENNSYLVANIA

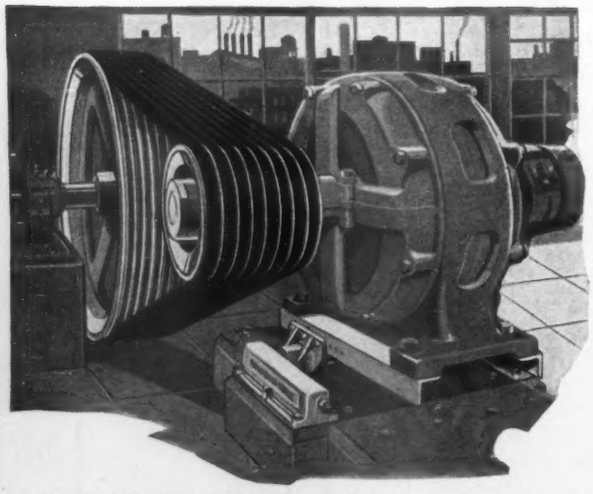
# ROCKWOOD PIVOTED MOTOR DRIVES



Two Rockwood Drives connected to Ingersoll-Rand compressors in plant of large dry dock company in Houston, Texas. One on left, 100 h.p., one on the right, 150 h.p. Rockwood Drives increase compressor capacity and reduce power and maintenance costs.

## Typical Rockwood Drive Performance

## Rockwood Drives are superior for *any* belt-driven compressor



Any V-belt drive is improved with the use of Rockwood pivoted motor bases. Many hundreds of Rockwood Drive bases are now being operated with V-belts to increase the life of the V-belts, decrease maintenance and power costs and improve driven machine performance. The illustration shows the Rockwood Pre-shrunk Black V-belts—designed by Rockwood engineers to be an improvement in V-belt dependability and performance. Rockwood sell their own *complete* V-belt drives. Literature is available. *Write for it.*

Over 60,000 Rockwood Drives for all sizes of motors, from fracti to 500 h.p. prove the superiority of using the weight of the motor to k the belt tight for short center drives. Thousands of these installati are with compressors and ice machines where they show improved c pressor performance and increased output, save power and eliminate annoyance and expense of drive take-ups.

By pivoting the motor any desired part of the motor weight is used maintain initial belt tension automatically and regardless of chang belt lengths. As the load increases or decreases the reaction of the mo field about the pivot point increases or decreases the belt tightness that the drive can be set to operate at minimum tension to handle maximum compressor load—and be depended on to automatically ma tain such tensions indefinitely—with practically no further care. W Rockwood pivoted-motor Drives compressors can be operated to ma mum capacities. The power saving may be from 5 % to 10%. The dr upkeep expense is lower and its first cost usually is less than for ot drives.

Special designs are available for compressor manufacturers to use standard equipment, up to 25 h.p. A free trial offer is available to industrial plant that desires to try out a Rockwood pivoted motor b Every drive is unconditionally guaranteed to be satisfactory "or y money back". WRITE TO YOUR DEALER OR TO THE FACTO FOR RECOMMENDATIONS AND PRICES.

**Rockwood Manufacturing Company**—*Indianapolis, Indian*

### ON THE COVER

IN AUTUMN the outdoors beckons to everyone and most of us get into the open at every opportunity. Accordingly, our cover picture seems appropriate at this season. It shows a stretch of the Delaware River, looking upstream toward the gap that has been cut through and across a ridge of highly resistant quartzite. Lying at the base of the Pocono Mountains and within two hours' drive from both New York City and Philadelphia, Delaware Water Gap is a popular vacation and recreation area.

●

### IN THIS ISSUE

ALTHOUGH modern transportation facilities make building materials of all sorts available in every section of the country, the Southwest still finds adobe acceptable for many of its structures. Walls of mud withstand the elements satisfactorily in that semiarid section, and form an effective insulation against heat and cold alike. Closely akin to adobe are the sod houses that the early settlers built on the western plains. Recent news dispatches tell of one such home for three persons that was erected in Kansas in 1877 for $10.05. But thoughts of comfort and durability, rather than economy, nowadays impel people of moderate means in the Southwest to build with adobe.

●

JOHN Henry is the best known of all negro legendary laboring men. Several books have been written about him, including one by Roark Bradford of *Green Pastures* fame. In all of these stories, John Henry meets his death in competition with some mechanical device. In our presentation of the gigantic figure he plays the rôle of a master rock driller. And, true to pattern, he "beats down" a steam drill, but the exertion puts him in his grave.

●

THE maintenance of modern air transport planes has become an exacting task in the performance of which highly skilled workmen and marvelously ingenious machines combine forces. No effort is spared to make every aerial journey absolutely safe so far as freedom from mechanical troubles is concerned. *Inside the Hangar* tells an interesting story of how commercial aviation companies safeguard their passengers by keeping flying equipment in tip-top condition.

●

THE lead mines of Wales are the oldest producing properties of their kind in existence, and some of them promise to go on giving metal to the world for many years to come. This is being insured by driving a tunnel many miles long to drain the water that had made extraction of the ore both difficult and expensive. We are privileged to present a description of this work through the courtesy of J. C. Allan, joint managing director of The Halkyn District United Mines, Ltd.


# Compressed Air Magazine



Copyright 1937 by Compressed Air Magazine Company



**Volume 42** **SEPTEMBER, 1937** **Number 9**

C. H. VIVIAN, *Editor* — J. W. YOUNG, *Advertising Manager*
A. M. HOFFMANN, *Assistant Editor* — J. F. KENNEY, *Business Manager*
D. Y. MARSHALL, *European Correspondent*, 243 Upper Thames St., London, E. C. 4
F. A. McLEAN, *Canadian Correspondent*, New Birks Bldg., Montreal, Quebec.

## EDITORIAL CONTENTS


Buildings Made of Mud—*Carey Holbrook* ..... 5407
Driving a Mine Drainage Tunnel—*J. B. Richardson* ..... 5412
Inside the Hanger—*C. C. Harrington* ..... 5415
The Guitar Makers ..... 5421
John Henry—*William S. Powell* ..... 5422
Heavy Jacks Push Pipe Through Fill ..... 5425
Painting Stripes on Highways ..... 5426
Atom Smasher ..... 5427
This and That ..... 5428
Editorials—The Mexican Nile—Germany's New Highways ..... 5429
Industrial Notes ..... 5431
Petroleum Production Gains ..... 5431a


## ADVERTISING INDEX


Air-Maze Corporation ..... 32
Allis-Chalmers Mfg., Co. ..... Third Cover
American Air Filter Co., Inc. ..... 15
Bethlehem Steel Co. ..... 11
Bucyrus-Erie ..... 29
Burgess Battery Co. ..... 31
Combustion Engineering Co., Inc. 27
Dayton Rubber Mfg. Co., The ..... Insert 4
Diesel Publications, Inc. ..... Insert 3
Direct Separator Co., Inc., The 31
General Electric ..... 22
Goodrich Co., The B. F. ..... 7
Hercules Powder Co., Inc. ..... 8
Industrial Clutch Co. ..... 24
Ingersoll-Rand Co. ..... 6, 10, 19, 23
Jarecki Manufacturing Co. ..... 30
Jenkins Bros. ..... 25
Johnson Corporation, The ..... 32
Koppers Company ..... 14
Lebanon Steel Foundry ..... 13
Maxim Silencer Co., The ..... 30
National Forge & Ordnance Co. 31
New Jersey Meter Co. ..... 30
Norton Company ..... 12
Rockwood Mfg. Co. ..... Second Cover
Rotor Air Tool Co., The ..... 21
S.K.F. Industries, Inc. ..... 20
S.K.F. Steels, Inc. ..... 9
Socony-Vacuum Oil Co., Inc. ..... Insert 1-2
Staynew Filter Corp. ..... 3
Texas Company, The ..... 4–5
Timken Roller Bearing Co., The 16
United States Rubber Co. ..... 17
Vogt Machine Co., Inc., Henry 18
Waukesha Motor Co. ..... 28

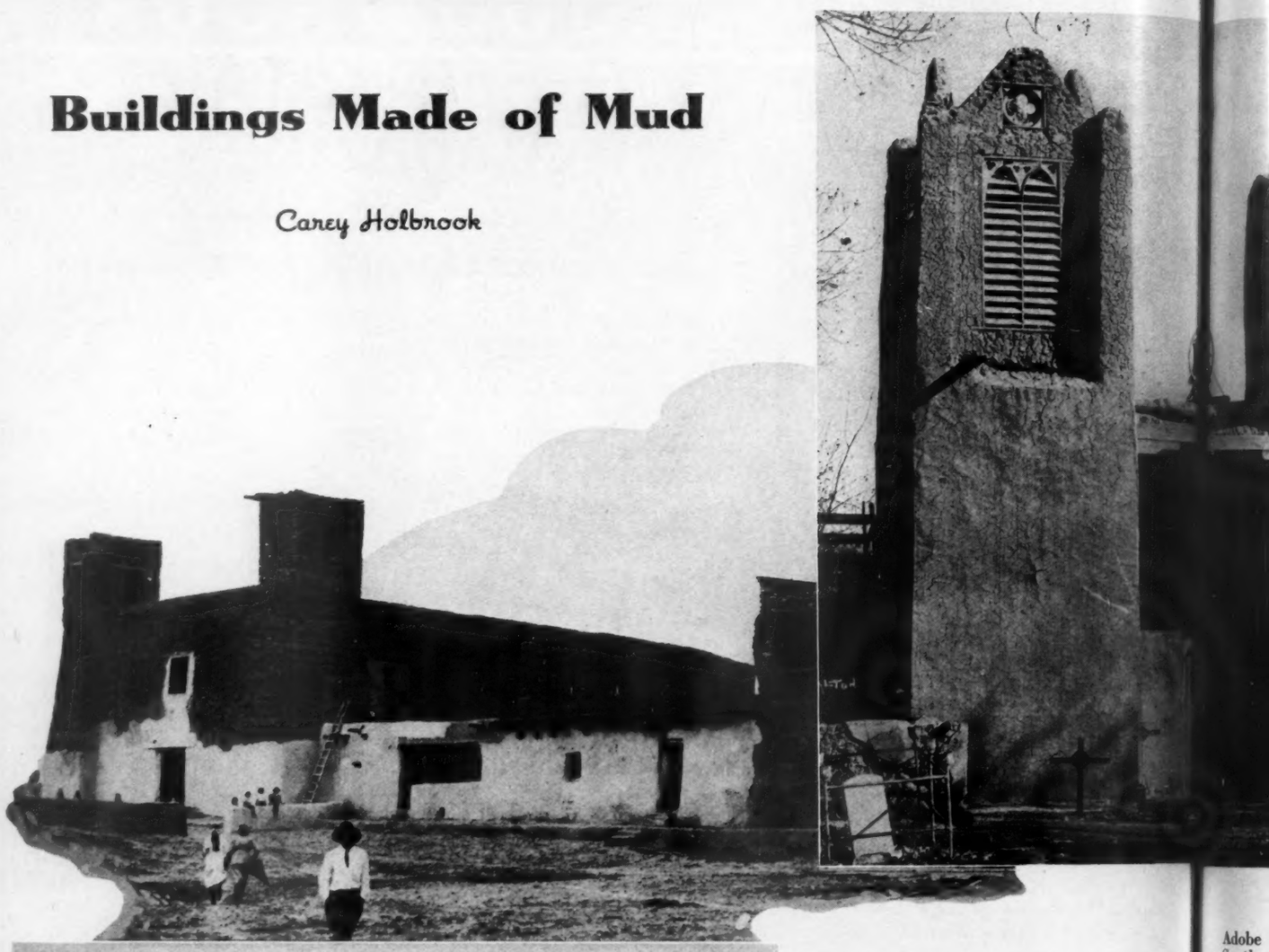


**A monthly publication devoted to the many fields of endeavor in which compressed air serves useful purposes. Founded in 1896.**

Published by Compressed Air Magazine Company. G. W. MORRISON, president; R. A. LUNDELL, vice-president; F. E. KUTZ, secretary-treasurer.
Business, editorial, and publication offices, Phillipsburg, N. J.
Advertising Office, 11 Broadway, New York, N. Y.
Annual subscription price: domestic, $3.00; foreign, $3.50. Single copies, 35 cents.
Compressed Air Magazine is on file in many libraries and is indexed in Industrial Arts Index.

# Buildings Made of Mud

Carey Holbrook



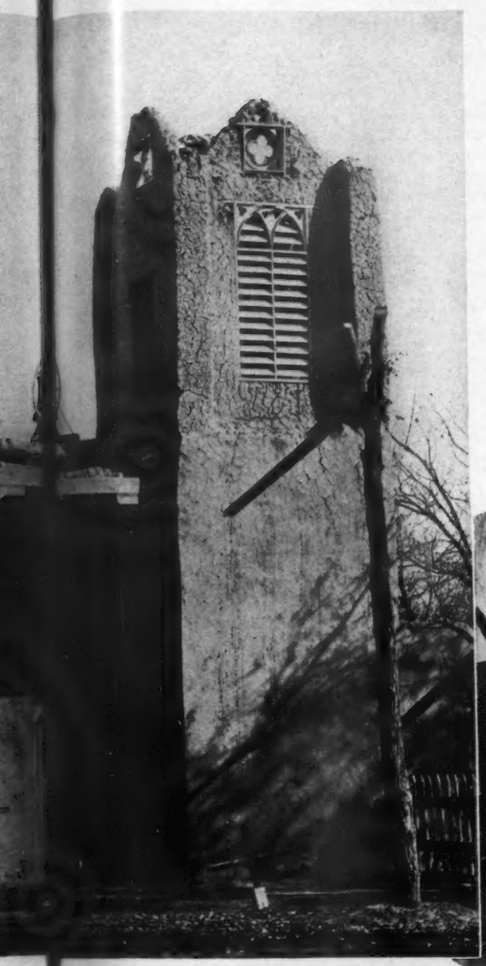
NOT EVERY builder of a home is so situated that he can walk out on the site of his new dwelling, stake off the location for his basement, start excavating, and out of that hole in the ground remove all the material necessary to rear the walls of his structure. But this is no uncommon practice in that wide stretch of country extending from Colorado down through New Mexico and Arizona and bulging over into Texas, California, and Mexico, taking in roughly all the semiarid land known as the great Southwest where rainfall is light. For in this region of high mesas, rugged mountains, and incredibly ancient villages, a large percentage of the houses, both ancient and modern, are constructed of mud. Adobe they call it, or, in the soft language of the country where vowels and consonants are merely things to be discarded at will, simply 'dobe.

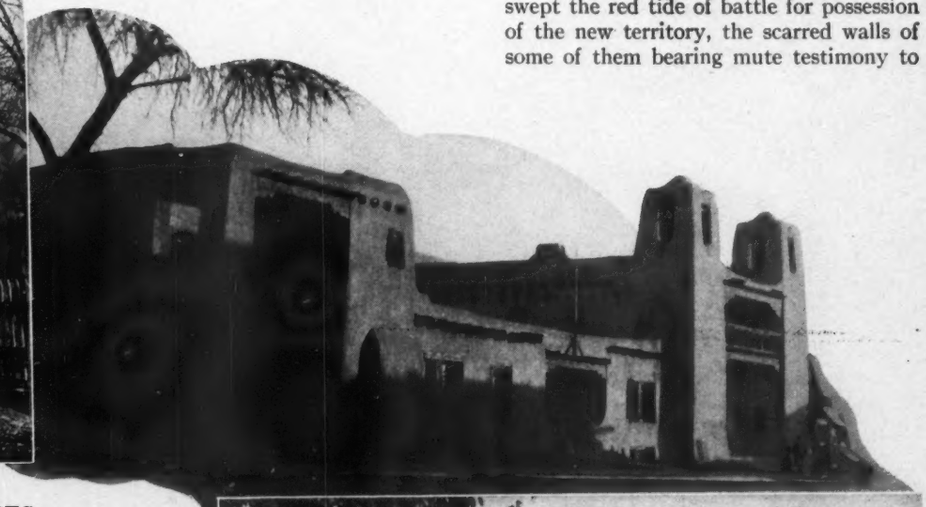
No temporary structures are these homes of earth. Long before Coronado came sweeping through the land in 1540, searching for the fabled cities of Cibola, the Indians had learned the art of making 'dobe bricks from which to build their dwellings. Some of these still stand, and though wrinkled and ancient and drab they are serviceable to this

day. Unchanged they have watched the years march by Behind their brooding walls babies have been born, lived out their allotted spans, and new generations have sprung up to take their places. Solid and squat and enduring, reared by hands of copper hue in some long-forgotten past, they are, apparently, destined to go on forever.

While most of these old mud houses are 1-story affairs, with walls 18 inches and more thick and with roofs and floors made of the same material, some of the Indian pueblos or towns contain community dwellings that are two and three stories high. Within them live many families who reach their quarters by means of ladders leading from floor to floor. Up and down the Rio Grande in New Mexico are several such pueblos, the best example of which is Taos with its apartment houses, covering several blocks, in which perhaps a hundred or more Indian families find shelter. The structures are entirely of adobe, with solid walls plumb as any modern building and plastered on the outside with a mixture of mud and straw which is renewed from time to time.

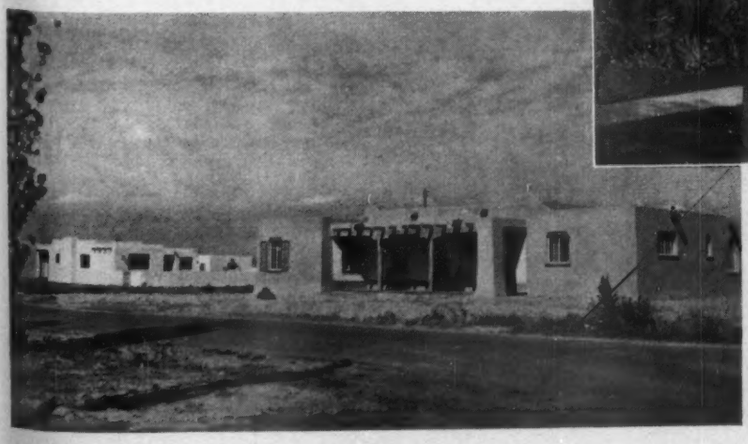
No better example of the permanent character of adobe can be found than the mission churches built by the Franciscan fathers throughout the Southwest. Many of them have withstood the ravages of the centuries, and are still used as houses of worship. Around these massive structures swept the red tide of battle for possession of the new territory, the scarred walls of some of them bearing mute testimony to





### OLD ADOBE STRUCTURES

Adobe is the natural building material in much of the Southwest and, accordingly, has been used for all classes of structures, both large and small. Because of the scarcity of the rainfall in that region the buildings are enduring, and many of them have been in continual use for several centuries. On the opposite page and above at the left are pictures of three adobe churches. The one at the bottom is the Mission of Santa Ana pueblo, which is believed to have been erected in 1598. Just above it is the mission of Acoma, reputed to be America's most unusual church and the largest mission in the Southwest. Across the center, above, is the old mission at Tomei, N. Mex. The thickness of the walls can be observed in the towers.

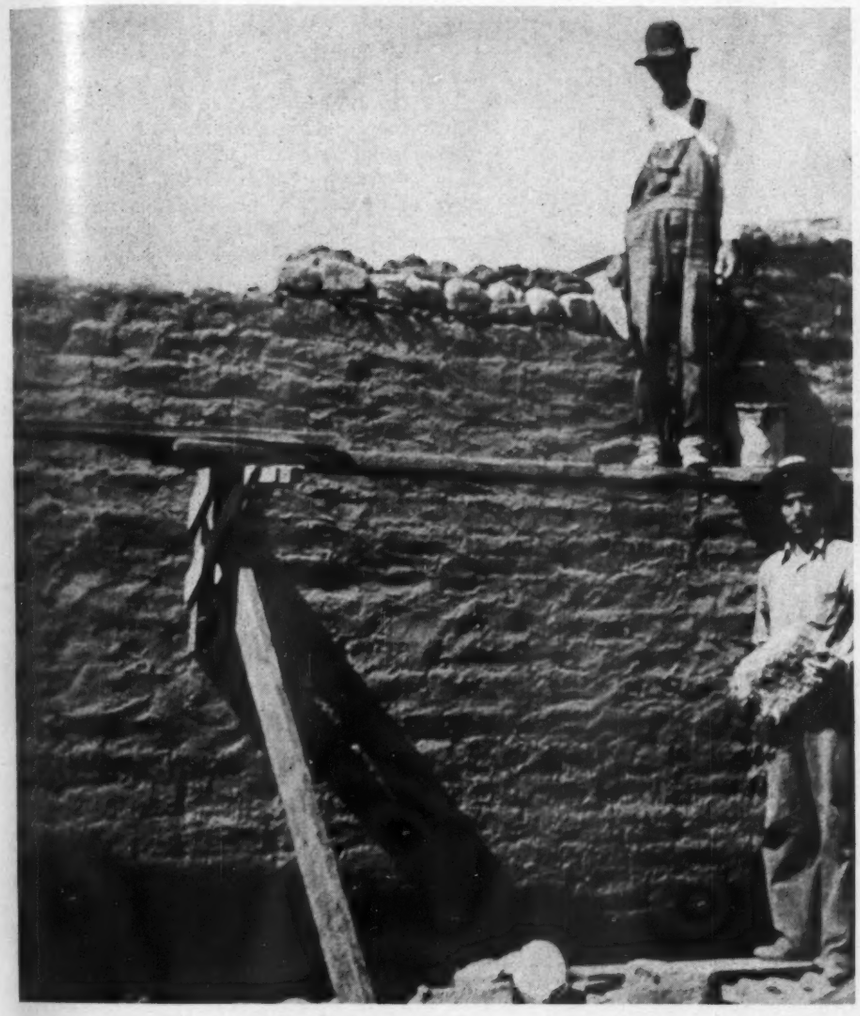


### MODERN ADOBE BUILDINGS

Residents of the Southwest like adobe construction because it provides warmth in winter and coolness in summer. In the hands of skilled artisans, adobe buildings can be made architecturally pleasing, as these views prove. At the left and just above are shown dwellings in New Mexico, and at the top, right, is the art gallery at Santa Fe, N. Mex.

## STEPS IN MAKING ADOBE BRICKS

Throughout the region where adobe structures abound, clay is commonly found near the surface. Usually, to obtain the raw material, it is necessary only to remove a few inches of top soil. Into that excavation water is poured, and the worker gets into the gummy mass with bared feet (1). Using a shovel or a hoe (2), he works or puddles the mud until it is of the desired consistency, adding a little straw to serve as a binder. This stiff mixture is then shoveled into wooden forms (3), which are generally 14 inches long, 10 inches wide, and 4 inches deep. Next, the tops are smoothed off by hand (4). After the bricks are sufficiently dry to be handled, they are removed from the forms (5), turned on edge, and allowed to cure in the sun until there is no danger of further shrinkage. Adobe bricks of the size described weigh about 30 pounds each, and can be bought for from $12 to $15 a thousand.



**BUILDING WITH "TERRONES"**

Terrones are blocks of clay cut from grass-covered ground, the fibers serving to bind the mass together. Properly constructed terrone buildings are as enduring as those of adobe.

the bitterness of that struggle for supremacy.

In 1621 Father Alonzo Benavides came to New Mexico as first custodian and supervisor of missions. Twenty-six new friars accompanied him, and they immediately entered upon an ambitious program of church construction, using adobe almost exclusively as their building material. In the stiff parchment pages of the Memorial on New Mexico, which Father Benavides presented to the King of Spain, reference is made to the Villa Real de Santa Fe de San Francisco, later shortened to Santa Fe, as the head of this kingdom. It lacked, said the noted friar, one principal thing, a church, a situation he immediately set about to remedy by constructing the adobe mission of San Miguel de Santa Fe "to the glory of God our Lord."

Little more is known about the history of San Miguel Mission until the time of the Pueblo Rebellion in 1680, for the precious parish registers were burned by the Indians after the Spaniards evacuated Santa Fe. Its thick adobe walls, however, were unharmed, and the church was rebuilt. For more than three hundred years since then it has turned back the blazing sun of a wide land, and wind and rain have beat upon its scarred sides; but the walls still stand, proof of the enduring quality of adobe as a building material.

San Miguel Mission is not the only structure of its kind to bear witness to the durability of adobe. Well preserved is the mission of Zia pueblo, which was built early in the seventeenth century by Fray Bernardo de Marta and escaped destruction in the Pueblo Rebellion. It is of adobe, and with the exception of the facade, which is stuccoed, is barren of plaster. But even those unprotected walls have held off the elements for more than 200 years.

Probably the most remarkable example of adobe construction is the mission at Acoma. This church is located at the summit of a barren rock that rises more than 400 feet above the surrounding country. There is no vestige of sand or soil on top of this wind-swept cliff, and every ounce of adobe used was carried there on the backs of Indians over a trail cut into the solid rock. The edifice was begun in 1629 by a Franciscan priest, Friar Juan Ramirez, and stands today as a monument to human endurance and as a testimonial to the time-defying elements of adobe. Forty years were spent in building this mission. It is more than 150 feet long and 40 feet wide. Its front walls are sloped to form huge buttresses topped with square towers. The great carved roof beams are 40 feet long and 12 inches square and were brought to Acoma from a mountain many miles distant. How the Indians transported them up the tortuous path to the summit is a source of wonder.

Many other missions built of the soil on which they rest are still to be seen in the Southwest. Among the more famous of these are the Mission of Lorenzo de Picuris, where Father Zarate was martyred; the Mission of San Antonio de Isleta, earliest seat of Indian education; the church of the Village of Santa Cruz; the mission at Tomei; the missions in the Indian pueblos of Santa Ana, Domingo, San Felipe, and Tesuque; the church of San Felipe de Neri in the old-town plaza at Albuquerque, and so on.

From the record of Castaneda, famous scribe who accompanied Coronado on his expedition up the Rio Grande in 1540, we

**APPLYING EXTERIOR FINISH**

In modern adobe construction, metal lathe or small-mesh chicken wire is used to hold the stucco with which the exterior wall surfaces are covered.

**THE NATION'S FIRST HOUSE**

**The adobe structure in the foreground is claimed to be the oldest house in the United States. It stands in Santa Fe, N. Mex. The outlines of the 'dobe bricks can be plainly seen where the exterior facing of mud plaster has fallen away from the walls. Even though unprotected, bricks of this kind have withstood the elements for many decades.**

have an authentic account of the manner in which adobe bricks were made by the Indians. His account, written in Spanish, reads: "They gather a great pile of twigs of thyme (sagebrush) and sedge grass and set it afire, and when it is half coals and ashes they throw a quantity of dirt and water on it and then mix it all together. They make round balls of this, which they use instead of stones when they are dry, fixing them with the same mixture which comes to be like a stiff clay."

Another method practiced by the Indians was to mix the mud with some kind of a binder and to lay it in a mass, using a framework of poles which constituted the form. The rows of poles were set far enough apart to give the required wall thickness, the spaces at the intersecting points being stuffed with weeds or grass. This framework was filled with the adobe, which was tamped down and allowed to dry, after which a section of poles was removed and placed on top of the rising wall. This method of construction is similar to that known as *pisé de terre*, which means rammed earth and which is used extensively abroad. Prof. Ferdinand N. Menefee, of the department of engineering mechanics at the University of Michigan, experimented with a building of rammed earth in 1927, using native Michigan soil, and the finished structure compared favorably with others of that type.

But by far the most common practice, followed not only by the Indians and the early Spanish settlers but by modern builders as well, is to form the adobe into bricks, which are allowed to harden in the sun until they are ready for use. For this purpose, the top surface of the ground is usually removed and the desired claylike material exposed. Into the resulting depression water is poured, and the adobe mixer, equipped with a hoe, gets into the mess with his bare feet. Small quantities of straw are added to serve as a binder, or, if the builder is a native or an Indian, dry stable manure is used. This mass is stirred with the hoe until it is about the consistency of thick mortar, and is then shoveled into rectangular frames; is smoothed flush with their upper edges; and left in the sun to set. As a general thing the forms measure about 10x14 inches and are 4 inches deep, although adobes of many sizes are made. When sufficiently hard so that the frames can be removed, the bricks remain where they are on the ground to undergo further shrinkage. This curing process is a very important step in adobe construction, and should be continued for several months, for green material, or material that has not been aged long enough, is liable to crack in the wall. Adobe bricks of the usual size will weigh about 30 pounds each, and may be purchased from a native maker for anywhere from $12 to $15 a thousand.

The method of finishing a structure of this kind depends entirely upon whether it is to be a modern one, such as may be found in all the southwestern communities, or one for an Indian or a native. In the latter case adobe mortar is used to bind the bricks together, and coats of adobe are applied like plaster to the outside as well as to the inside walls, covering all cracks and leaving a smooth brown surface broken by specks of yellow where the straw shows through. The inner surfaces are sometimes covered with whitewash; and the outside finish must be renewed occasionally as wind and rain wear it thin.

In the matter of flooring, though wood is often employed, the Indians, almost without exception, continue to spread a thick layer of adobe on the ground where it is tamped down and smoothed until it is hard and glossy. Sometimes fresh blood, caught when a steer is butchered, is mixed with the mud. When this is properly done, the product is a floor that is nearly as hard as concrete, dark in color, and virtually dustless. It has one fault, however, it will not stand up under soap and water.

For roof joists, poles of native wood are used. These extend from wall to wall and are given just the suggestion of a tilt on one end to prevent the roof from being absolutely flat. Between these joists are nailed boards, or the crevices are filled with brush or grass upon which to spread the roofing material, which is also adobe. This is laid on 5 or 6 inches thick and is packed down firmly. Such a roof, when it has had time to dry, will keep out all ordinary rains and leak only during a prolonged downpour or when snow is allowed to remain upon it until it melts. Should that happen, the dweller has only to mix another batch of adobe, shovel it into the spot, and the job is done.

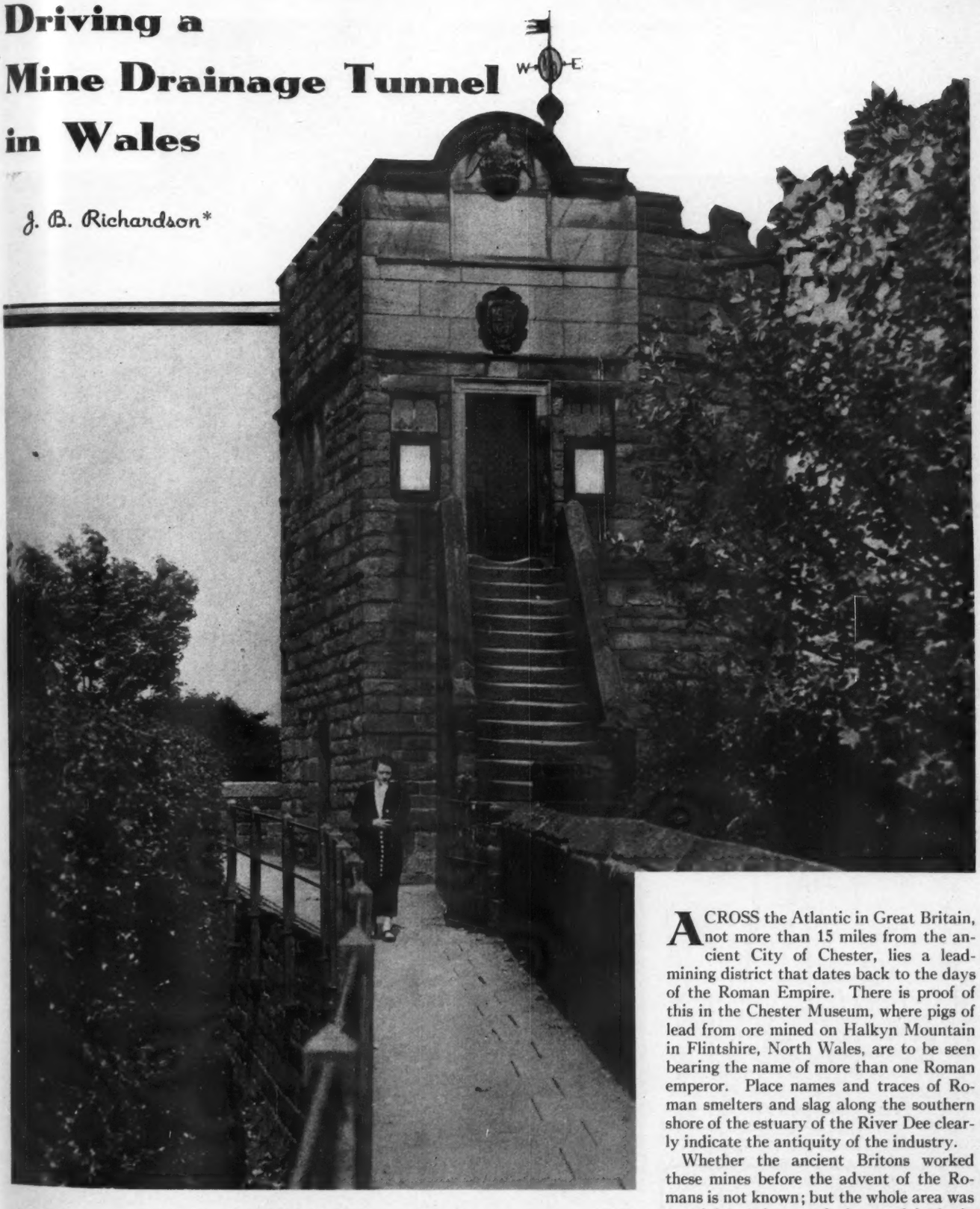
There is still another method of making adobe bricks, and this is also used extensively in rural sections. Thick squares of mud are cut directly from some grass-grown spot. These are called *terrones* and are similar to the chunks of sod from which the early settlers in the prairie country built their homes. The big difference between a sod house and one of *terrones* is that the former is a temporary structure that soon goes back to the earth from which it was taken, while the other has all the enduring qualities of a regular adobe building. Necessarily, a house constructed of such material is rough looking, and the walls are inclined to be uneven because the bricks are uneven and have grass roots running through them, giving them a fuzzy appearance. But a builder who knows his "stuff" will make a sturdy structure out of *terrones* that will defy the elements for many years.

In the case of a modern adobe house, regular cement mortar is used between the joints the same as with brick or tile. If the adobes are of ordinary size, then only one course of bricks will be required for a wall 10 inches thick. The outside finish will be stucco, which is applied to metal lath or to small-mesh chicken wire fastened to the adobe with nails. This makes a permanent and attractive finish. In lieu of these materials, a rural dweller, desiring a similar exterior finish, will drive the wall full of eight- or ten-penny nails, spaced 10 inches or so apart, with the heads sticking out about halfway or far enough to hold the coat firmly.

The principal advantage of adobe construction for a native or an Indian is, of course, the saving in cost. He has the material for his home right in his own back yard, and with the labor of his own hands can put up a thoroughly habitable dwelling without laying out much cash. His doors and windows, together with a few items of hardware, are about all that he will have to purchase. For the builder of a modern home, however, the saving in cost as between adobe, on the one hand, and brick or tile, on the other, is very slight. But in the Southwest the adobe house is more comfortable than any other type of construction of comparable cost because the walls are of such thickness that they keep the heat in during the cold months of the year and the blazing sun out in the summertime.

# Driving a Mine Drainage Tunnel in Wales

J. B. Richardson*



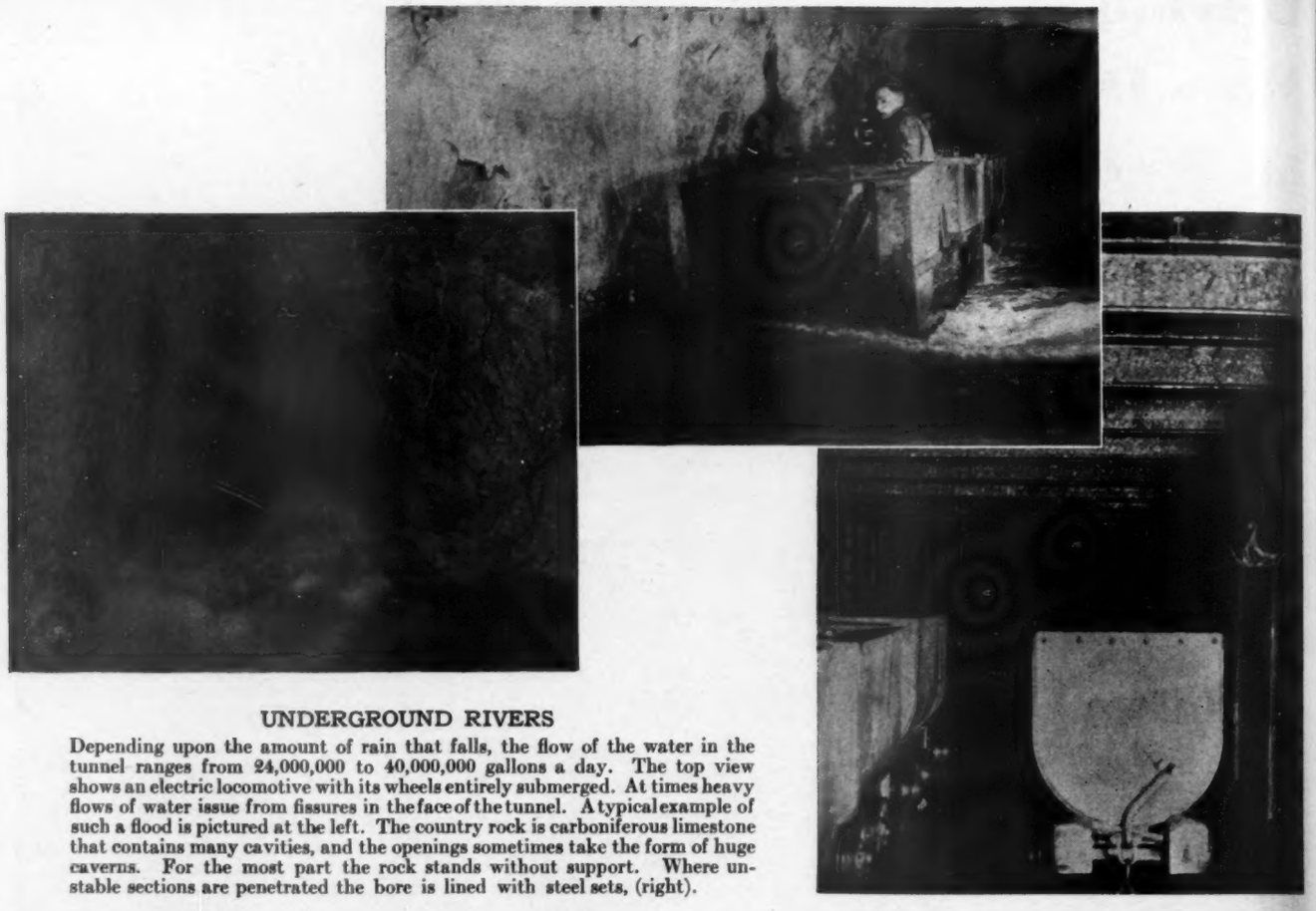
KING CHARLES TOWER, CHESTER

The work described in the accompanying article is being conducted near the historic City of Chester, about 180 miles northwest of London. The Romans founded it, probably about 48 A.D., and it is mentioned in the writings of Ptolemy and Antonius under its original name of Deva. As it was an important military outpost, the Romans built a wall around it; and the city, today, bears the distinction of being the only one in England that is still so encircled. Sections of the enclosure, which is 2 miles long, rest on the original foundations. There are four gates, all of which have been rebuilt from time to time. This picture shows one of the watch towers and a part of the wall.

ACROSS the Atlantic in Great Britain, not more than 15 miles from the ancient City of Chester, lies a lead-mining district that dates back to the days of the Roman Empire. There is proof of this in the Chester Museum, where pigs of lead from ore mined on Halkyn Mountain in Flintshire, North Wales, are to be seen bearing the name of more than one Roman emperor. Place names and traces of Roman smelters and slag along the southern shore of the estuary of the River Dee clearly indicate the antiquity of the industry.

Whether the ancient Britons worked these mines before the advent of the Romans is not known; but the whole area was certainly being actively exploited in Elizabethan times. In 1568 a legal fight between an individual landlord and the Crown resulted in a decision to the effect that the King of England had exclusive right to mines of gold and silver, but that

*General Manager, The Halkyn District United Mines, Limited.

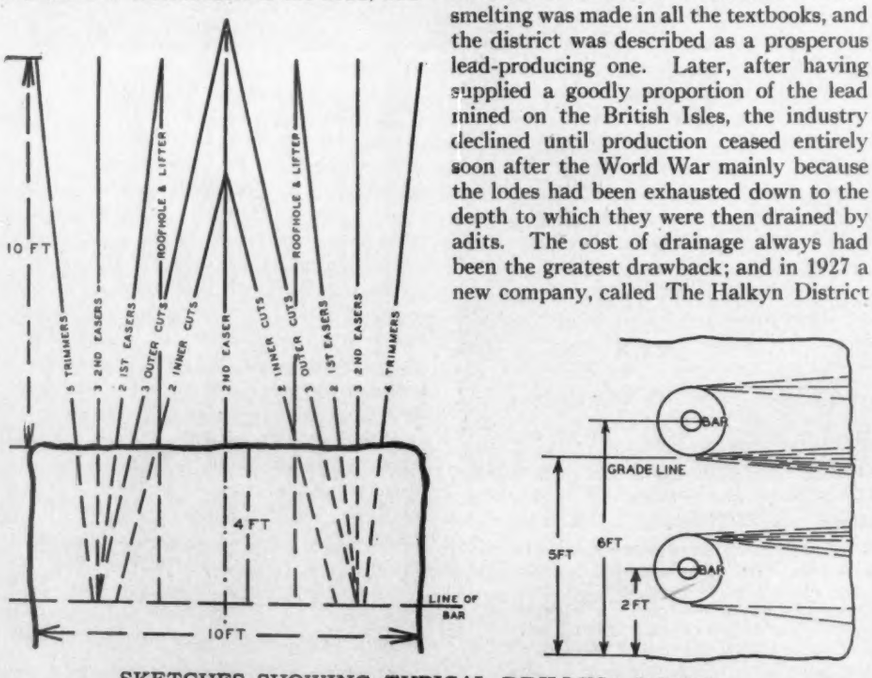


**UNDERGROUND RIVERS**

Depending upon the amount of rain that falls, the flow of the water in the tunnel ranges from 24,000,000 to 40,000,000 gallons a day. The top view shows an electric locomotive with its wheels entirely submerged. At times heavy flows of water issue from fissures in the face of the tunnel. A typical example of such a flood is pictured at the left. The country rock is carboniferous limestone that contains many cavities, and the openings sometimes take the form of huge caverns. For the most part the rock stands without support. Where unstable sections are penetrated the bore is lined with steel sets, (right).

from all mines other than those the landlord could claim royalties. Lodes that were operated in 1740 are still being worked. As recently as 1899 a lawsuit established the fact that the Grosvenor family, of which the Duke of Westminster is the head, had purchased the rights to only the lead in all the common lands in the reign of Charles II, and that all the other metals and minerals belonged to the Crown.

Towards the end of the last century, mention of the Flintshire furnace for lead smelting was made in all the textbooks, and the district was described as a prosperous lead-producing one. Later, after having supplied a goodly proportion of the lead mined on the British Isles, the industry declined until production ceased entirely soon after the World War mainly because the lodes had been exhausted down to the depth to which they were then drained by adits. The cost of drainage always had been the greatest drawback; and in 1927 a new company, called The Halkyn District United Mines, Ltd., was formed, amalgamating the interests of nine old mining companies and two drainage companies for the primary purpose of extending a sea-level tunnel in a southerly direction so as to drain the whole of the consolidated area.




SKETCHES SHOWING TYPICAL DRILLING ROUND

The country rock in Flintshire is a highly fissured carboniferous limestone which contains a large number of vugs, some of them forming huge caverns hundreds of feet in length, width, and depth. Owing to the nature of the formation, the underground water varies in proportion to the rainfall, the flow through the tunnel ranging from 24,000,000 to 40,000,000 gallons a day, according to the season of the year. It is therefore apparent why this method of drainage was decided upon. Much of the difficulty experienced with flood conditions is attributable to the River Alyn. In following its normal course to the point of confluence with the River Dee several miles above Chester, some of the waters of this stream seep through fissures and old mine workings into the tunnel and by this circuitous route reach the Dee.

At the beginning of the present tunneling activities, in 1929, the engineers in charge were pioneers in mechanical mucking in the British Isles, and, working at one face only, attained an average weekly advance of 160 feet. This was maintained over long periods. The average length of the rounds broken was from 6 to 6½ feet;

and the maximum monthly advance was 1,086 feet in July, 1933. Up to the end of that year the tunneling operations were in the hands of Messrs. John C. Allan and J. L. Francis, managing director and chief engineer, respectively, of the new company.

The driving technique has recently been studied and improved upon. The round as now drilled is on the cut within a cut principle, and was developed by the writer in conjunction with J. E. Lambert of Imperial Chemical Industries, Ltd. Since the middle of August, 1936, an average advance of 9.3 feet has been cut per round, and this is nearly equal to the major dimensions of the tunnel.

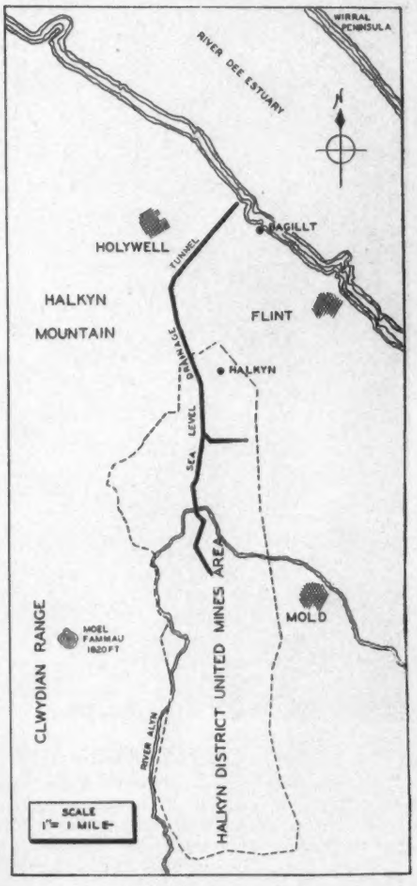
The simplicity of the set-up is worth noting. It consists of one horizontal ratchet bar carrying two Type S-70 Ingersoll-Rand rock drills. Since their installation, these have been converted to automatic feed, and the same bar serves as the anchor for a 15-hp. slushing hoist. On more than one occasion, in an emergency, the ganger driller in charge of the shift put in and fired the complete round.

The limestone is easy to drill, and the rate of penetration, under ideal conditions, is as much as 30 inches per minute. The rock, however, is "springy" and difficult to break unless care is taken in directing the holes. Hollow, round, 1¼-inch steel is used; the explosive is Polar ammon-gelignite; and electric detonators serve in the tunnel as well as at all the development faces in the mines. As the accompanying map shows, the tunnel heading is now some 8 miles in from the sea. Including the branch tunnel, approximately 9 miles have been driven to date, leaving nearly 6 miles still to be excavated to reach the southern boundary.

The tunnel has a width of 10 feet and a height of 8 feet, and has a ditch along one side. The latter is 4 feet 6 inches wide, from 2 feet 6 inches to 3 feet deep, and has a grade of 1 to 1,000. This drain is excavated to a point approximately 50 feet back from the heading so as to leave ample room for the slide and the siding for the empty muck cars. Only when excessive volumes of water are encountered is it carried right up to the face. There have been occasions when floods up to 10,000 gpm. have poured into the tunnel and tended to choke the ditch with sand, overtaxing its capacity. Normally, however, the drain has been adequate. A considerable proportion of the water discharged into the sea is used at nearby Bagillt for industrial purposes, especially in the manufacture of rayon.

**A DRILLING CREW**

Drilling at the tunnel face is done with two drifter drills mounted on a horizontal bar, which also serves as an anchorage for a 15-hp. hoist with which the broken rock is mucked into cars. Drilling was started with hand-cranked S-70 machines, but these were later converted to automatic feed. In other parts of the mine many other types of drills are used, the latest to be added being six DA-30 drifters. This picture shows a typical drilling set-up in the tunnel. The central figure is John Dakin, a ganger driller or foreman, who has on occasions drilled and blasted a complete round unassisted.

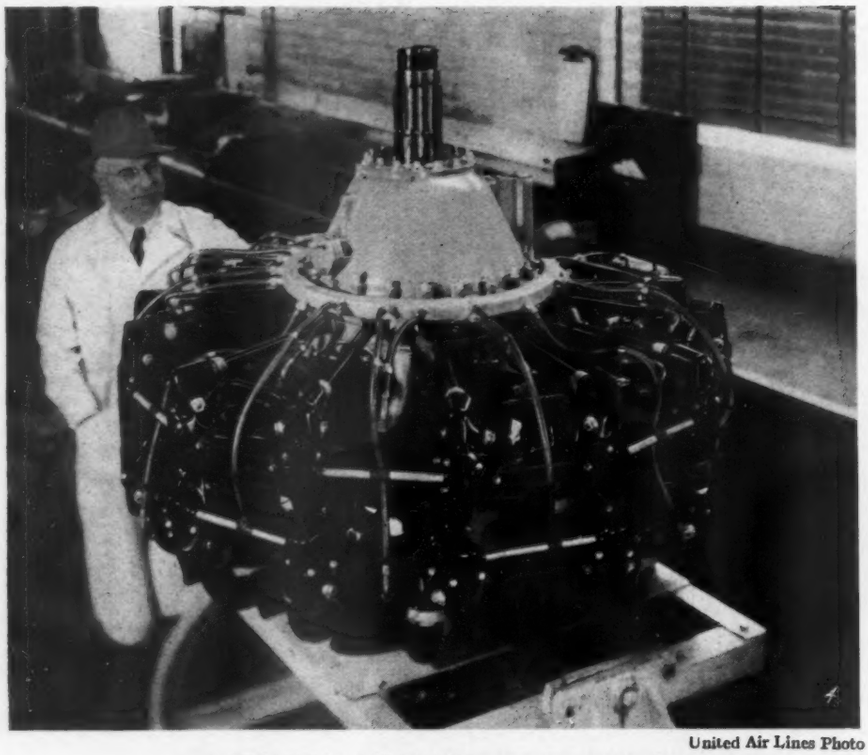



**LOCATION MAP**

**The Halkyn District United Mines are located in northeast Wales close to the estuary of the River Dee. As the map shows, the tunnel is being driven from the coast, and has thus far penetrated more than 8 miles, exclusive of a 1-mile branch. Much of the water encountered in the mine comes from seepage from the River Alyn, the course of which is shown. Some of the discharge from the tunnel is used for industrial purposes at Bagillt.**

Since the production of lead was started three and a half years ago, the tunnel simply has been the main development face in the mine and, like all the other faces, has had to rely on supplies and transport and has received no priority in any way. Just how bad track conditions underground sometimes are is plainly shown in one of the accompanying illustrations.

Although the job is proving to be anything but a sinecure, the engineers and men engaged in thus reviving lead mining in Great Britain and in placing it upon an up-to-date basis are fortunate in that they are working in the midst of famous beauty spots and holiday resorts. Chester, Conway Castle, Snowdonia, and the Horseshoe Pass will be familiar names to those that have toured North Wales while visiting the "old country," not forgetting the River Dee where "Mary called the cattle home."



United Air Lines Photo

**A MODERN AIRPLANE POWER PLANT**

This 14-cylinder, radial-type engine represents the latest thing in motive power for flying. It is capable of developing more than 1,200 hp. Because of advances in design and the use of high-strength alloys, however, it is no larger or heavier than 300-hp. engines of a few years ago. Modern transports use two such engines, but one of them can sustain a plane in flight at 100 miles an hour.

# Inside the Hangar

C. C. Harrington

THE usual crowd of airport spectators stare skyward as Flight Seven banks into the wind for a landing. The huge plane settles gracefully to the runway, touches ground gently, then lumbers like a clumsy pachyderm toward the passenger ramp. With a final cough its twin engines become silent, and the two whirling disks still into 3-blade propellers.

The passengers are scarcely out before five or six overall-clad men are swarming over the plane, as though it were some silver bird that had dropped in to have its feathers plumed—and is in a hurry about it. These men have come from the hangar, and they meet every plane that arrives. It is they that keep the "ships" in the air. For every pilot on the air-line payroll there are five men in overalls. It is their work just as much as the pilot's skill that gives a modern air traveler an assurance of safety. To an air line safety is synonymous with maintenance.

A few years ago it was not unusual for a plane with a dead motor to sit down in some farmer's cornfield. Whereat the farmer was as irate as the passengers—after they had recovered from their fright. And the ire of each party was perfectly justified—the farmer for having a wide swath cut in his bumper crop and his cows scared out of a week's milk, and the passengers for being dropped in the wilds of Ohio after they had paid for transportation to Chicago. A modern airliner is almost never found in a cornfield. The motors used by air lines today are as reliable as grandfather's old gold watch, and the planes themselves are so faultproof that the birds eye them with envy.

What has brought about this change for the better? First is the widely advertised improvement in the design and construction of both the plane and the engines. New alloys and improved methods of carburetion have permitted the builders to crowd 1,000 hp. or more into a power plant no larger or heavier than the old 300-hp. units. And at the same time they have improved the carrying power and strength of planes until they compare with freight cars. Furthermore, they have increased the speed of air transportation to amazing figures. Nor is the end in sight.

But it takes more than $100,000 planes and a group of pilots to make a reliable air line. To touch the heart of this reliability you have to enter the back door of the airport where grease and overalls are the rule. Open the hangar door and you will find the other side of aviation.

To return to our arriving plane: The maintenance men go to work immediately putting wooden clamps on the control surfaces to prevent the wind from moving them, pinning the landing gear, and stamping about impatiently until the operating crews get out of the way. This plane is going to lay over less than two hours before it leaves on its return trip, and these men have plenty to do in the *interim*.

As soon as the plane is empty, two men climb inside. Another comes scooting up on a tractor, pulling a long towing iron. This is fastened to the tail wheel of the plane. After the wheel blocks are removed and a man is stationed at each wing tip, the plane is trundled away and disappears in the hangar. There it is set upon by a small army of men, each with a single purpose in mind. Instrument and radio experts, as well as a couple of cleaners, crawl inside. A ladder is brought up to each engine and two men start taking off the cowls. Underneath the plane one man shoots grease in the joints of the retractable landing gear, while another drains samples of gasoline from the sump of each fuel tank. There is going to be no water in the gasoline when the airliner takes off. The mechanics go over the entire engine with exacting care—cylinders, carbureters, magnetos, plugs, wires, everything is examined with trained eyes and fingers. A magnetic plug is removed from the oil sump. If there is any undue wear in the interior of the engine, particles of the metal will collect on this plug and will indicate a fault long before it reaches dangerous proportions.

Meanwhile other mechanics are inspecting and greasing the propellers and governors, the control surfaces, and the de-icer overshoes. Sections of the fuselage are removed and the control cables gone over. The storage batteries are dropped down and tested, generally to be replaced by fully charged units. Tires are checked for proper pressure and examined for cuts. A small break means replacement.

In the cockpit the instrument man tests the instruments against a list detailing the history of each unit for the preceding 400 hours of flying time. Even though they are performing perfectly, instruments that have been in service longer than 400 hours are replaced by reconditioned units. The other instruments are inspected and checked so far as is possible with the engines idle.

The modern instrument panel contains at least 40 instruments, telling everything from the temperature of the engines to whether you are flying upside down or not.

Nor is the radio mechanic's job any sinecure. In addition to a transmitting set, he has four separate receiving sets to examine. Each is tested and checked for noisy tubes and outside interference. The slightest wheeze results in adjusted shielding or new tubes. The radioman also climbs all over the plane's outside, which is draped with as many antennae as a battleship. Insulators and wiring of each are carefully inspected. The shielded loop of the new homing device is tested for proper operation. If a set does not give good performance, the inspector pulls out the entire unit—much like you pull a plug from a wall socket. Everything is designed for speedy replacement.

Inside the passenger cabin, cleaners prepare the plane for its next hop. Fresh seat covers are put in place, upholstery is brushed and vacuum cleaned, floors are scrubbed, windows are washed, and metalwork is polished. Seat belts are gone over, water tanks filled, lights tested, and even the electric razor is given a workout. The interior of a 3-year-old plane has the same luster and appearance of newness as one fresh from the factory. After the engines and cowls are back in place and the outside inspection is completed, cleaners descend on the plane with high-pressure water hoses, steam jets, and long-handled brushes. They scrub the outer surfaces of the ship as though intent upon wearing the metal away. No one has ever seen a dirty-looking plane on a modern air line.

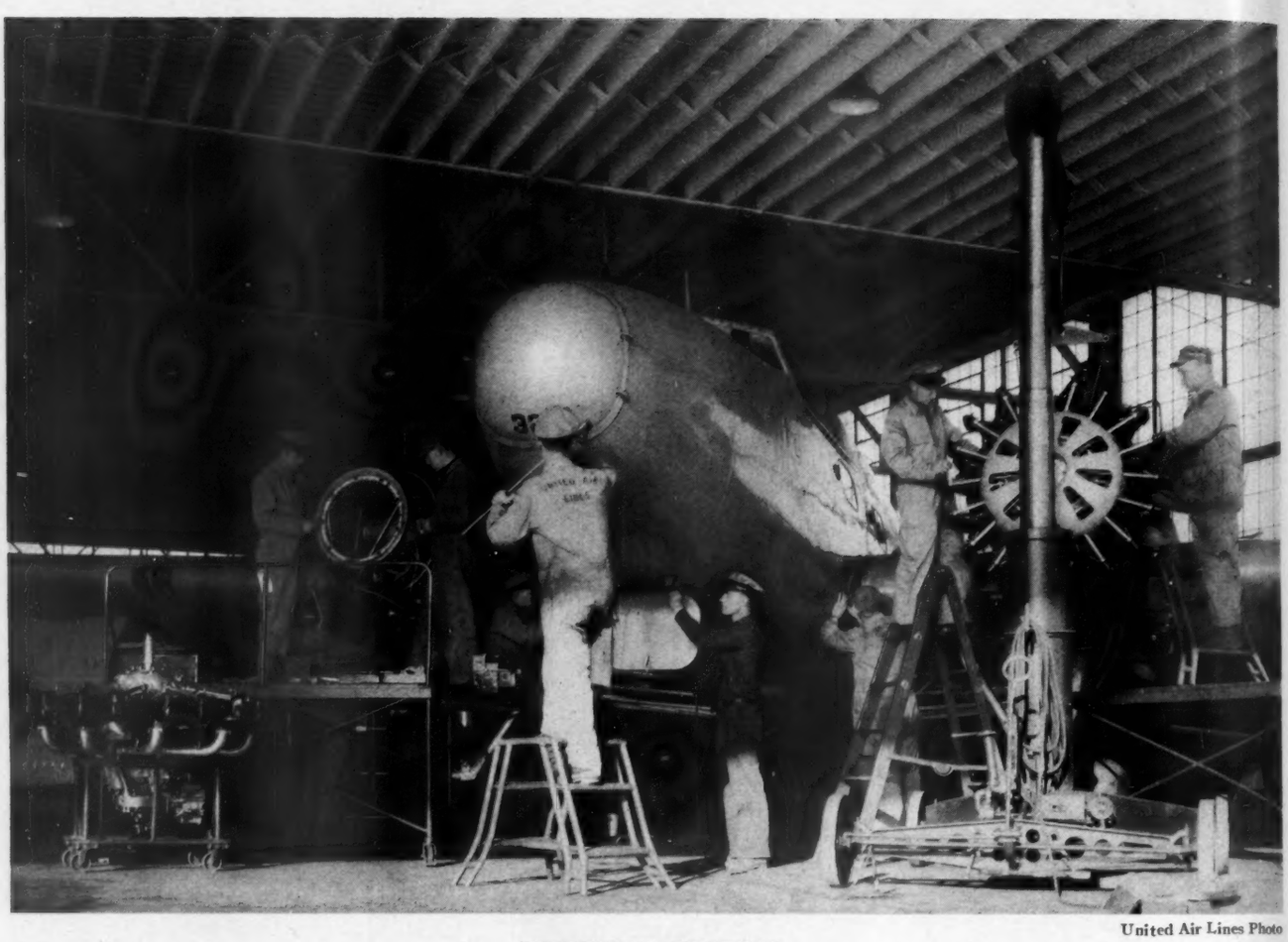
When a plane arrives at a terminal the chances are that everything from the motors to the electric razor are operating in perfect order. But this does not deter the maintenance crew in the least. Their motto is to catch trouble hours before trouble has a chance to catch them. The result is that during the past three years of air-line operation in the United States there has not been an accident directly attributable to the maintenance department.

On the other hand, suppose a plane comes in with a noisy engine, or the mechanic inspecting the magnetic plug in the oil sump finds a cluster of ominous-looking steel chips clinging to it. No attempt is made to repair that engine. Instead, the cowling is removed and a hoist attached to the motor. Four brackets back of the firewall are unbolted, the gas, oil, and electric lines disconnected, and the entire engine is swung away from its nacelle. A spare unit is quickly substituted and the lines reconnected. In less than two hours the plane is ready to go.

Where the average motorist may change the spark plugs in his car two or three times during the machine's lifetime, the slightest rough performance of an airplane engine on either of its two magnetos means a new set of plugs. In any event, after every 40 hours of flying, new plugs are installed all around.

**A MAN-MADE BIRD**

**The first of the Pan American Airways clipper ships for South American service is shown against a bank of clouds above New York. This was the forerunner of the line of larger planes developed since then for Pacific Ocean service and still more recently for experimental flights across the Atlantic preparatory to starting regular service.**



United Air Lines Photo

**REMOVING ENGINES**

**The start of a major overhaul of a 2-engined transport plane. One engine has been taken out and is shown at the left ready to be trundled away to a room where it will be reduced to its component parts for detailed examination. A hoist is in position for removing the right-hand engine.**

It is no jest that some air lines spend more money for spark plugs than they do for oil. And they use plenty of oil.

After the plane is completely inspected and cleaned, it is taken out of the hangar and the motors tuned up to about 1,900 rpm. The mechanics then check the performance on each of the two ignition systems and note the operation of the instruments that tell how the motor is doing. When the plane is turned over to the flying personnel, the latter has complete assurance that everything is in perfect order.

It may be repeated for emphasis that what has been described was just a daily inspection, that is, routine work done during the few hours that a transport plane lies over before again taking off. It may be idle anywhere from one to five hours. To the maintenance force this is a minor job that must be done in jig time. The system followed insures that nothing can be missed. Each item that must be inspected is listed, and the mechanics sign for every job they do. Not only that, but an inspector follows up the work, and his signature backs up each mechanic's. If any faults are noted on the pilot's log sheet, these are likewise signed for by the man who corrects them and by the inspector. This may be a routine job, but it is done thoroughly.

The 80-hour overhaul is something else again. After a plane has flow for that period of time it is taken out of service and given a thorough going over. Everything is checked that can be examined without dismantling the entire plane. The engines are washed and all the spark plugs changed. The compression of each cylinder is checked, the landing wheels are removed and the brake gear is inspected. With the plane resting on jacks, the landing gear is operated and carefully tested. Control cables, hinges, brackets, and surfaces are inspected and lubricated where necessary. A list of each detail covered would run into the hundreds. Suffice it to say that after the 80-hour overhaul a ship has had its innermost secrets scrutinized. When it is turned over to the operating department it has had weeks removed from its age.

After a plane has been 400 hours in the air it gets a complete overhaul. When that stage in its life is reached it is sent to the main shop of the air-line, where nearly everything except the wings and fuselage are taken completely apart. The personnel at the main shop numbers several hundred and ranges from skilled mechanics to seamstresses, from mechanical engineers to clock workers. In one room, delicately fingered men work on precision instruments, while in an adjacent building a huge hydraulic press shapes metal forms. To tear down and reconstruct a plane is all in the day's work for these people.

Standing on portable racks all around the closed hangar of the main shop are fifteen or twenty engines, all waiting to be installed. The rest of the hangar is crowded with the planes, themselves, like giant birds deprived of half their feathers. Engines are missing, wing and fuselage sections are gone, landing gears are replaced by steel jacks, and ailerons, rudders, and elevators are strewn all over the floor. Busy men are everywhere. These planes are there only two or three days and then must go back to take up scheduled flights with all the vitality of new ones.

A plane towed in for its 400-hour overhaul is set upon by a group of determined workmen. First they take off each of the engines and all the instruments and radio equipment. While the latter are being carted away to other rooms, the engines, with the propellers still hanging on their noses, are mounted on portable stands and pushed over to a large machine shop. Then the plane is literally torn limb from limb by a crew of expert dissectors. Sections of the fuselage and wings are pulled off, ailerons and elevators are removed, and the re-

mainder is jacked up so that even the landing mechanism can be taken away.

Next the dissectors crawl inside the wings and fuselage, pulling out worn cables, applying grease to pulleys and link bearings, and examining everything with expert eyes. Even the spars and ribs of the structure do not escape inspection. A wing that shows distortion or weakness comes off and a new one goes on. The plane has to be practically new when it leaves the hangar.

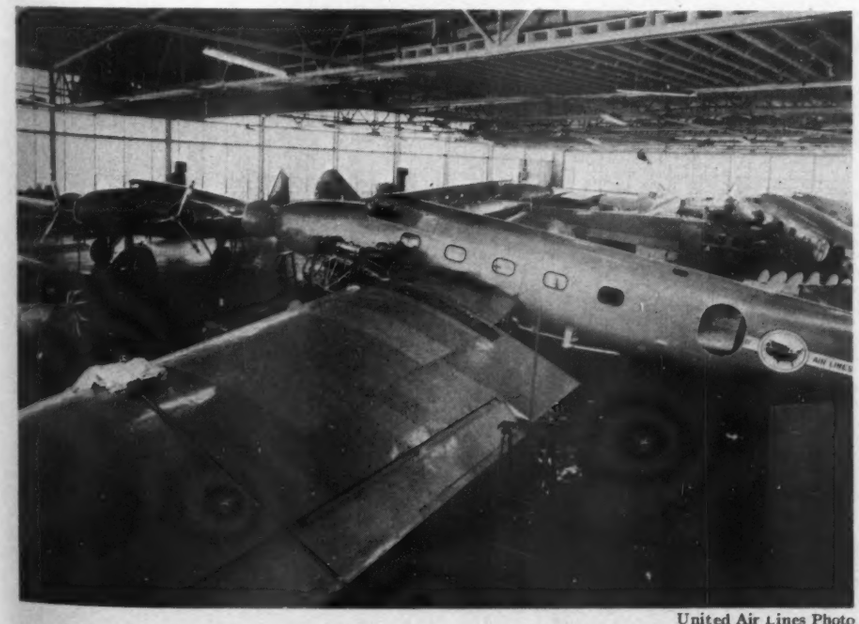
Meanwhile the engines have been taken to the overhaul shop. Although essentially a machine shop, through which plenty of grease and dirt pass every week, it is amazingly clean and as busy as a beehive. As each engine enters it is greeted with open arms or, rather, open wrenches. The propeller is removed and sent to a separate department. Then the engine is deprived of its accessories, such as magnetos, starter, carbureter, etc. These go to special overhaul tables. The mechanics do not lay aside their wrenches until there is not a bolt or screw left to take out. The proud machine, which a few moments before could pull a 12-ton load at better than 100 miles an hour, now lies in hundreds of assorted pieces.

United Air Lines Photo

**METAL WORKING SHOP**

All sorts of special work can be done here by the staff of highly skilled mechanics. Not only are metallic plane parts repaired but new ones are also made. As will be noticed, the operations are largely performed by hand.

In this dismembered condition the engine is placed on a movable rack and wheeled over to a man who looks like he is stirring a large pot of soup. It is boiling naphtha, and he dips each piece in this cleansing solution. The scrupulously clean parts are then dried by jets of compressed air. Paint is removed from the cylinders by sand blasting. Next the pieces are put on a clean rack and moved to the center of the shop. There they are taken in hand by a group of eagle-eyed men working at a long table. With micrometers they measure the dimensions of shafts. They check the wear of cylinders to see if they need reboring and oversize pistons. Each piece is inspected for flaws, excessive wear, or cracks. The shop is even equipped with microscopes, and what they reveal the unaided eye would never believe. They are used to help detect minute cracks in metallic surfaces, some of them smaller than the finest hair. But even microscopes will not reveal them all, so the magnaflux test is resorted to.



United Air Lines Photo

**UNDERGOING MAJOR OPERATIONS**

The principal air lines believe in the old adage that a stitch in time saves nine. After a plane has spent 400 hours accumulated time in the air, it visits the main shops for a complete overhaul. It is dismantled, all moving parts are torn down and carefully checked, all instruments are tested, and the entire plane is cleaned and spruced up. So far as performance goes, the transport is as good as new when it is reassembled and returned to service.

An inspector picks up a small shaft. It is perfectly clean and highly polished. Even when a thumb nail is run over it not a scratch is felt. He then dips the shaft in a bubbling solution. After a few seconds it is pulled out and washed in another tank. Thereupon he shows it to you. Your eyes pop with astonishment, for there, standing out as plain as the lines on your hand, is a crack 3 inches long.

"Every part of the motor that is made of steel is subjected to this magnaflux test," the inspector explains, "and we have yet to find a cracked part that wasn't shown up by this method. First the piece to be tested is magnetized. Then it is dipped in an air-agitated solution, which is nothing more than a light oil with iron filings in suspension. After the excess oil is washed off the piece, the iron filings will remain lined along even the smallest crack, revealing the fault so plainly that it can't be missed.

"Cracked parts are immediately junked. The perfect pieces are demagnetized and returned to the motor rack. We have to rely on visual inspection to catch the faults in parts made of aluminum and its alloys. To make this as effectual as possible we use microscopes, for we want to catch cracks and flaws before they become bad enough to be seen with the naked eye. This keeps us three jumps ahead of trouble."

By the time the engine rack leaves the

United Air Lines Photo

**INSIDE THE INSTRUMENT ROOM**

**Here the delicate instruments which contribute much to the safety of modern transport flying are inspected, cleaned, and tested at regular intervals. This room is immaculately clean, and its atmosphere not only is controlled as to temperature and humidity but is also kept under a sufficient pressure to preclude the possibility of dust getting in from outside.**

inspection department it holds everything necessary for reassembling the unit. Faulty parts have been replaced by new ones. Such accessories as magnetos, pumps, and carbureter have been brought from their individual test stands. New spark plugs and a new ignition harness also have been added. Thus, starting at one end of the assembly line in hundreds of small pieces, the engine is rapidly built up to its former splendor. The cylinders have been repainted, and all other parts are clean or new.

At the far end of the room is a soundproof enclosure. There the engine is mounted and attached to fuel and ignition lines. Oil is added, and a stub propeller fastened on its shaft. In a few moments it roars in noisy freedom, gobbling up gas and spitting flames out of the exhaust stack. It is run for at least four hours, while its fuel consumption and pulse are carefully checked. If its performance does not come up to standard, the engine is returned to the overhaul shop and again goes through the entire process from tear down to reassembly. The majority leave the test stand as good as new.

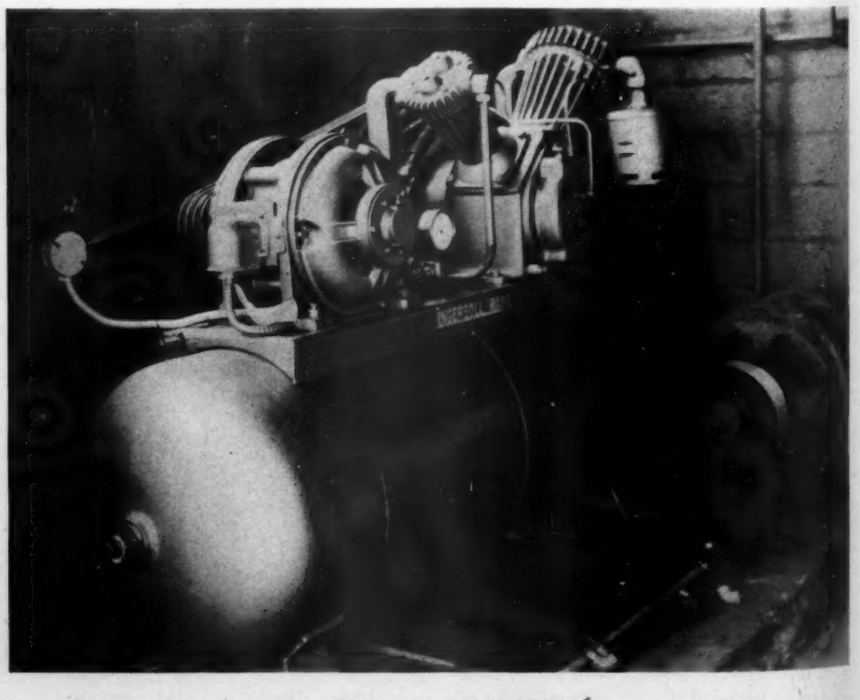
If you are mathematically inclined, you will delight in the propeller shop. Here one speaks of camber, balance, and twist. Planimeters, odd-shaped scales, and balancing racks line the room. "Propeller failure nowadays," the superintendent tells you, "is practically unknown. Our greatest trouble is caused by cinders and small stones on the airport runways. These particles are sucked up by the whirling blades and leave nicks and even cracks along the edges. We can smooth out the nicks; but a cracked propeller calls for replacement with a new one."

Inspecting the blades for mechanical defects is only a small part of the work done in this shop. Each one must be set on a perfectly level table and checked by gauges and scales to see if it has the slightest distortion. Each blade must be balanced alone, then assembled and balanced with the other blades that form the complete propeller. A slightly unbalanced propeller whirling at 2,000 rpm. will make a plane shake like a threshing machine.

While one may saunter through the engine department in a white-linen suit and not pick up any grease, in the instrument room one can literally lie down on the floor and roll without gathering a smudge. This section is a pleasant place in warm weather, for it is not only as spick and span as an operating room but is air conditioned. Because of the delicate instruments in use, it is necessary to regulate the humidity and temperature. Nor is that all. The air pressure there is held sufficiently above that of the atmosphere to prevent dust from coming in from outside.

In these immaculate surroundings some two dozen nimble-fingered experts devote their entire time to reconditioning and checking the multitude of instruments required by a modern air line. Each man is a specialist and works at a table supplied with electricity, compressed air, and all kinds of precision tools. He can dismantle and reassemble the instruments he knows with his eyes closed. But he has a lot more to do than just tear down and rebuild. With a microscope he examines small shafts and jeweled bearings. Delicate micrometers are used to check for wear. To investigate the working of some types of instruments the men even use stethoscopes. After an instrument is overhauled it goes to its own special test stand and must prove itself as good as new.

In one corner of the room is a device that has been developed for automatically testing the gyro pilot—that astounding instrument which flies a plane 90 per cent of the time, relieving the pilot for his naviga-



**AN AIRPORT COMPRESSOR**

**This Ingersoll-Rand Type 80, air-cooled unit is installed in the shop of Eastern Air Lines at the Newark Airport. Compressed air is used by all air lines for operating pneumatic tools, for spray painting, sand blasting, and for cleaning and drying purposes.**

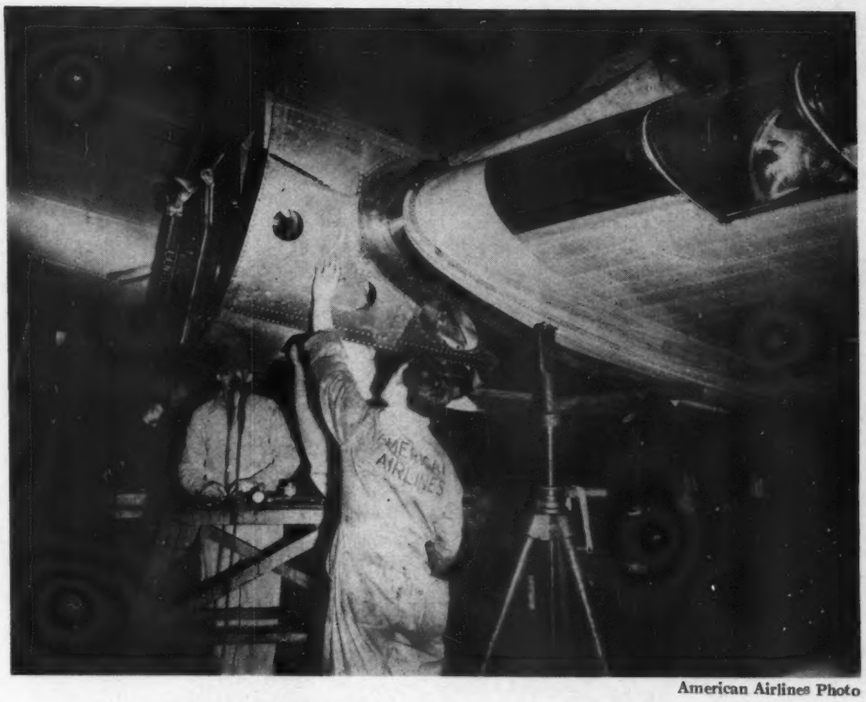
tion work and assuring a smoother trip for the passengers. To test this highly important instrument, a machine has been built that goes through all the gyrations of an erratically flying plane. On this the gyro pilot is mounted and subjected to four hours of the most severe plane movements that it will ever be called upon to undergo. If ever an instrument sweats, it is the gyro pilot at a time like that. At the end of the test period the gyro must line up exactly as it was set at the beginning. Otherwise it is again dismantled and inspected.

In the radio department is a large cage: but its purpose is to keep things out instead of in. The stands for the final test are built inside of it, because the copper screening that surrounds it shields the sets from outside electrical interference. Radio is the nerve center of an air line. By its means the transports not only navigate when out of sight of the ground but receive reports of weather ahead and keep in touch with their company offices. The tremendous increase in traffic at the principal airports makes landing without radio contact with the control tower about as hazardous as driving down Fifth Avenue with your eyes closed.

The shop also contains a battery department. Even with the use of generators on the engines and battery carts for ground starting, the drain on an airliner's battery is extremely heavy. Radios, lights, and instruments soon pull down the charge. The shop is equipped to recharge 24 batteries at one time, or to rebuild a battery cell from the plates out. Then there is a metalworking shop, where compressed air is used in large volumes, and an upholstery department to keep the cabin chairs in first-class condition, as well as a stock room storing more than 150,000 different items, ranging from pins for seat covers to spare wings for the largest ship.

But how about the maintenance men themselves? Where do they come from? That is what the air lines would like to know. Where to get men with aviation experience is a serious problem with them. Even an apprentice must have two years of airplane work back of him before he will be hired. This leaves the Government air forces and a few accredited aviation schools as practically the only sources to draw upon. The specialists in the radio and instruments departments nearly all come from radio plants and clock and instrument factories. The air lines have grown so rapidly and their equipment is in such a state of transition that they have had little chance to train men for their own work.

In the maintenance shops, employee morale probably reaches an all-time high. Each man is keenly interested in aviation and its development. He knows that people's lives and the company's success depend upon everyone doing a first-class job. Mistakes are few and poor workmanship unknown. If some fault does turn up during operation, it can be traced right back to the responsible man in the shop. For instance, suppose a bearing works loose 200 hours after Engine No. 1143 is put back in service. By looking through the life record of that engine the superintendent can ascertain who installed the faulty bearing. Such complete records alone are conducive to careful workmanship.



American Airlines Photo

**OVERHAULING ENGINE CONTROLS**

**The engine has been taken off so that it can be dismantled and inspected, and mechanics are minutely going over the control equipment in the nacelle. Note that the fuselage and wings are jacked up, the landing gear having been removed for checking. The de-icing equipment is shown on the edge of the wing at the upper right.**

But, it may be asked, does this almost perfect maintenance system of the major air lines insure safety? Don't things still go wrong mechanically? The answer is that they do and that they always will. But anything short of a wing dropping off can now be handled with little hazard to the passengers. Suppose a fuel pump fails. The pilot merely switches both fuel lines to the good pump on the other engine. If the fuel pumps of both engines break down he can use what is known as the wobble pump and feed fuel to each engine by hand. Again, what would happen if an ignition set becomes faulty? Each engine has two separate ignition systems, including magneto, wiring, and plugs. Either set alone will operate the motor smoothly. Take a fantastic case. Assume that a meteor tears the carburetor away from one of the engines. It will be dead then, sure enough. But the single surviving motor will lift the fully loaded plane to more than 5,000 feet and fly it there at considerably more than 100 miles per hour as long as the gasoline holds out.

Consider the landing mechanism, which many people worry about because it is pulled up while in flight. Say that the pressure pump on the landing gear fails and that the latter will not come down. There is another pump on the opposite engine that can be used. Suppose it, too, is out of order. The pilot can still work the wheels down by pumping the hand lever. If this is of no avail he might snap the wheels down by maneuvering the plane. If unsuccessful in this, he can come down to a fairly smooth landing anyway, because the wheels, even when fully retracted, extend about a foot below the bottom of the cabin.

There are, therefore, several alternatives to combat every known contingency. Whenever a new condition arises, means are promptly taken to guard against its recurrence. Moreover, when something unusual happens to a plane of one air line, that line immediately notifies all the other aviation companies so that they may profit thereby. In the same way the maintenance departments of all companies exchange information on overhaul methods and their experience with equipment. Like new discoveries in medicine, improvements in aviation maintenance are broadcast to all who are interested. Even companies that are direct competitors work hand in hand to make all flying safer. It is this fraternal relationship among the air lines that has made it possible for them to attain such heights of maintenance effectiveness in so short a time and that is largely responsible for the continual decrease in accidents on established air transport routes. In view of this splendid coöperation, it is little wonder that the reliability of American air lines is the envy of world aviation. Flying enthusiasts even now envision the day when the air will be our safest avenue of travel.

## The Guitar Makers

The making of musical instruments, as well as their playing, is an exacting art. Shown here are two operations in the finishing of a fine guitar. After being sanded smooth, it is sprayed with a filler composed of shellac and various proportions of lacquers. After this has dried, the surface is again sanded, this time with a very fine sandpaper which has been first dipped in benzene. The shading stains are next applied, followed by two coats of clear lacquer. Then follow a sanding, two more coats of clear lacquer, and another sanding. Rubbing with a cutting compound and finally with a wax polishing compound complete the process. A finished instrument is shown at the lower right.

# John Henry

## *A Mighty Man Was He*

William S. Powell

**He swung a 10-pound hammer in each hand, and could keep up the flailing all day.**

"Before I'll let that steam drill beat me down,
I'll hammer my fool self to death."

THE life and deeds of John Henry are familiar to labor gangs in almost every part of the country. Some of his fame has even spread abroad. He has become a legendary figure rivaling Paul Bunyan, the Hercules of the lumber camps. Although he was supposed to have died about the year 1873, even today songs and ballads concerning him are sung by men at work, by hobos, by coal miners and furnacemen, by river rats and wharf rats, by beach combers and sailors, by harvest hands and timbermen, some of them drunk and some of them sober.

Students of folklore have spent many years in research in an effort to determine how much of John Henry is fact and how much is fantasy. As there is no authentic documentary evidence available, the investigators have had to rely almost entirely on human testimony. Inasmuch as this sort of information is not always dependable, a vast difference of opinion has resulted.

As most often pictured, John Henry was a burly Negro, of great stature and prodigious strength, who was employed as a hand driller on the Big Bend Tunnel of the Chesapeake & Ohio Railroad near White Sulphur Springs, W. Va. The tunnel is 1¼ miles long and, because of the difficulties of construction, has never been double-tracked. It was originally lined with timber arches, which were afterward replaced with brick. The rock formation penetrated is very hard, but disintegrates when exposed to air, so much so that large cavities, sometimes 50 feet high, were found above the original timber supports at the time the brick lining was installed. Work on the tunnel was begun in January 1870, and John Henry is said to have driven steel from then on until his death.

In those days, rock drilling was done almost exclusively by hand. Usually two men, each wielding a long-handled hammer, alternated in striking the drill steel, which was held by another man and was partly rotated after each blow. Often they sang as they worked, and timed their blows with the rhythm of the song.

John Henry was easily the best steel driver on the job. Standing 5 or 6 feet from the drill, he swung a hammer in each hand, and so tireless was he that he could keep up the flailing all day. He used sheepnose hammers that weighed 10 pounds each and had switch handles 4 feet long. He rubbed the handles with tallow so that they would always be flexible and limber and not jar his hands and arms.

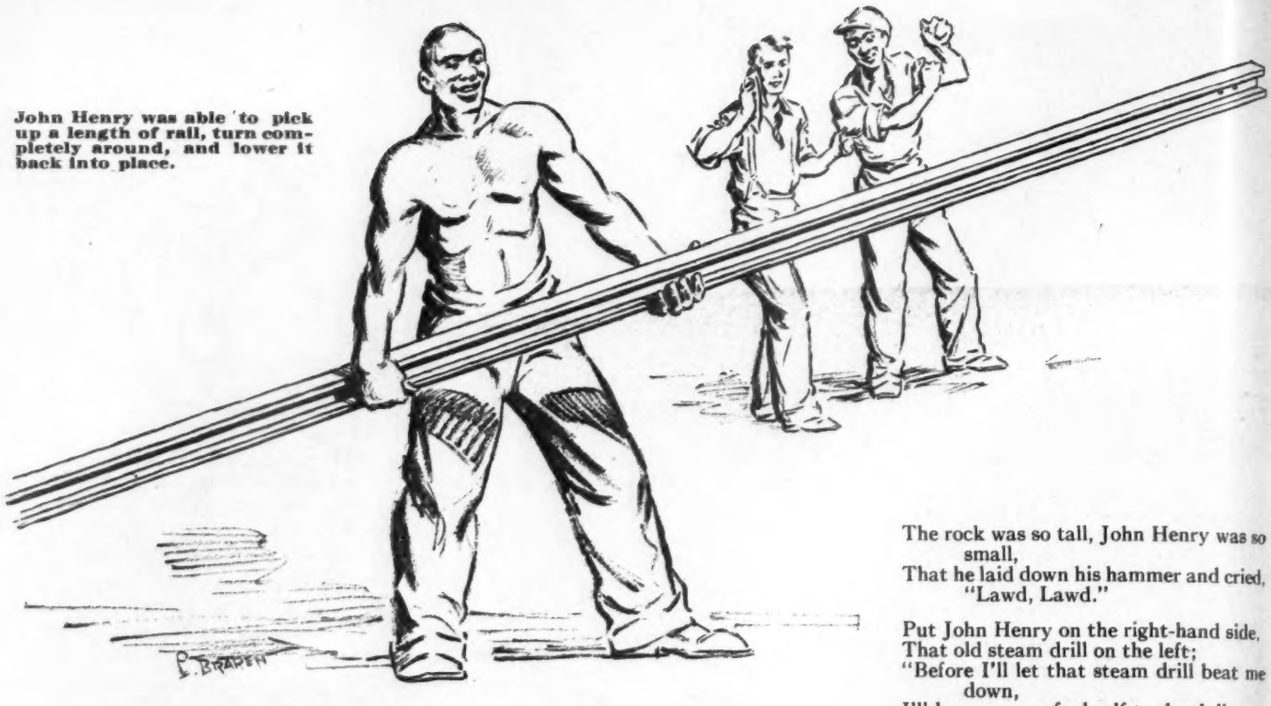
The tunnel was being advanced from both ends by the contractor, William R. Johnson. Steam-driven piston drills were being experimented with at the time, and their manufacturers were attempting to substitute them for hand drilling. As progress was so slow as to be discouraging, the contractors decided to give the mechanical drills a trial at one heading.

It so happened that John Henry was working in that end of the bore, and when he heard of the plan, he scoffed at it and boasted that he could sink more steel into rock than any steam drill that existed. The huge Negro gloried in his strength, and vowed that no machine would ever take his place. Knowing his capacity for work, many others on the job believed that he could beat the drilling contraption.

So a contest was arranged. It was to last 35 minutes, and if John Henry beat the steam drill he was to receive $100. The Negro procured two new hammers, applied plenty of tallow to their handles and, at the appointed time, the race got underway. When it was over, John Henry had drilled two holes, each 7 feet deep, and the steam drill had put down one hole 9 feet deep. John Henry proudly took the $100 and went home. After his evening meal he complained of a pain in his head, and sought his bed. The next morning he did not get up, and later it was found that he was dead. The exertion had caused a blood vessel to burst in his brain.

There are countless variations of this story, all of them vivid and realistic. Very old Negroes in the South tell tales of John Henry and swear by them. Each has his own version, and each believes that his version is the true one. Some say that they knew John Henry, and others that they knew people who knew him. One account has it that John Henry was hanged for murder at Welch, W. Va., another that he was in jail at the time of the drilling contest and that the contractor got him out in order that he might compete against the steam drill. If he won he was to be set free. Some people are very sure than John Henry was not a Negro at all, but a white man.

Probably the greatest controversy arises over the place from which John Henry came. Some think that he was from Georgia, others that he grew up in Virginia, Tennessee, North Carolina, Kentucky, West Virginia. There was a popular belief that he hailed from England or Spain or some other European country. This belief was probably fostered by the fact that there were railroad construction jobs in progress in Jamaica as early as 1843. Inasmuch as



**John Henry was able to pick up a length of rail, turn completely around, and lower it back into place.**

the United States and Jamaica enjoyed excellent trade relations, the John Henry tradition could easily have started there and been carried to this country.

There are people who maintain that John Henry was married to a girl named Liza, while others stoutly protest against this, saying that he was a single man and used to follow construction jobs from place to place. When one project was finished he would go to another, his fame as a steel driver having preceded him. He is said to have had thumbs as large as an ordinary man's wrist, and to have been able to pick up a length of rail, straighten up, turn himself completely around, and lower it back into place. There is a story to the effect that he once lifted a mule on to his shoulder to demonstrate his strength.

Such is the tradition surrounding the figure of John Henry—a figure closely associated with the hard-fisted, fast-living, almost savage Negro of the construction and labor gangs upon which the southern contractor placed his main reliance in the days when John Henry is supposed to have performed his mighty deeds. How much is truth, and how much is fiction, no one knows; but the fact remains that he has become a widely known character through story and song.

Negroes, as most of us know, have a habit of chanting as they toil, improvising as they go along and timing their movements accordingly. Take the leader of a drilling gang, for example. He may make up a stanza and repeat a line such as "Driving hard—huh" two or three times by way of a chorus, giving a grunt for each stroke of the tools. Or, ceasing operations to change a steel or for some other reason, possibly to scratch a tick, he might change the refrain to "Losing time—huh," and then start the crew off again in a somewhat different manner.

With a few phrases and countless combinations, limited only by the memory, observation, and imagination of the members of the gang, chanting of this sort may go on indefinitely. An outsider might not appreciate the singsong, because he is not familiar with the circumstances that inspired it, but to the Negro it is full of meaning, and the rhythm lightens his labor.

It is therefore not surprising that John Henry, the champion steel driver, and his deeds should be proclaimed in song. There are many of them, and they vary considerably as to his doings, a fact that can be explained by the Negro's native ability to improvise and by the steady coming and going in the construction camps of peddlers of all kinds, fortune tellers, banjo pickers, ballad singers, and followers generally, who broadcast the songs and probably altered them in doing so. Just how much they vary is brought out by the following verses chosen at random from among countless others:

John Henry was a very small boy,
He sat on his daddy's knee;
He picked up a hammer, a little piece of steel,
Says, "This hammer'll be the death of me."

Captain told John Henry,
Says, "A man ain't nothin' but a man;
If you beat that steam drill down,
I'll lay a hundred dollars in your hand."

John Henry told the captain,
Says, "When you go down to town
Bring John back a ten-pound hammer,
And he'll sure whip your steam drill down."

John Henry told the captain,
"A man ain't nothin' but a man,
And if I don't beat your steam drill down
I'll die with a hammer in my hand, Lawd, Lawd."

John Henry went up on the mountain,
He came down on the side;
The rock was so tall, John Henry was so small,
That he laid down his hammer and cried, "Lawd, Lawd."

Put John Henry on the right-hand side,
That old steam drill on the left;
"Before I'll let that steam drill beat me down,
I'll hammer my fool self to death."

John Henry said to his shaker boy,
Says, "Boy, you better pray,
For if I miss this six-foot steel
Tomorrow'll be your burying day."

The man that owned that old steam drill
Thought it was mighty fine,
But John Henry drove fourteen long feet
While the steam drill made only nine.

John Henry said to his loving little woman,
Says, "I'm sick and I want to go to bed;
Fix me a place to lay down, chile,
I got a rolling in my head."

John Henry had a pretty little woman,
The dress she wore was red;
She went down the track and she looked back,
Says, "I'm going where John Henry fell dead."

John Henry had a loving little woman,
The dress she wore was blue;
She went down the track, she never looked back,
Says, "John Henry, I'm leaving you."

John Henry had a loving little woman,
Her name was Polly Ann;
John Henry got sick and had to go to bed,
Polly bucked steel like a man.

Another version is to this effect:

John Henry sent for his shaker,
But he didn't want to go;
John Henry says, "Just one more round before going down,
I'm shipping on the Diamond Joe."

People came from the White House,
And went in the heading to see him drive;
John Henry laid down his hammer and cried,
"Captain, I'm a-leading of the steel-driving gang."

Queen Elizabeth came walking over the mountain,
And went in the heading to see him drive;
John Henry laid down his hammer and cried,
"Captain, I'm a-leading of the steel-driving gang."

John Henry had a little woman,
And she was dressed in blue;
She says, "Johnny, Johnny, my darling boy,
I have been true to you."

John Henry had a little woman,
She was all dressed in red;
People standing all 'round looking sad,
Says, "Poor John Henry is dead."

Still another version goes like this:

When John Henry was a little baby,
Sitting on his mother's knee,
Says, "The Big Bend Tunnel on the C & O road
Is going to be the death of me."

John Henry said to his captain,
"I feel a pain in my heart.
Before this steel drill shall beat me down
I'll hammer my poor self to death."

John Henry's captain got uneasy,
The mountains was a-cracking all around;
John Henry says, "Don't get scared,
It's nothing but my hammer falling down."

After John Henry died, his hammers remained behind him, and the other Negroes, realizing that the tools were the cause of his death, felt that the same fate might possibly be in store for them if they used them. So out of sympathy for John Henry, and perhaps out of superstition, an old darky from Georgia picked up one of John Henry's hammers when work was resumed the next day and uttered these lines:

This old hammer killed John Henry,
It ain't going to kill me buddy,
Take this old hammer and give it to the captain,
It ain't going to kill me buddy,
I am going back to Riddleville, Georgia,
That's my home buddy, that's my home.

With that, so the story goes, he turned the hammer over to his buddy and cautioned him to give it to the walking boss and to say to him that he was quitting and was going back home. He was so grieved over the loss of John Henry that he felt that he could go on no longer.

The word "captain" in the song refers to the superintendent on the job as well as to the boss, who was also spoken of as "walker," a contraction of walking boss, who went about the camp from one gang of workers to another.

Not only have numerous songs been written about him, but since John Henry's supposed death following his spectacular performance in tunnel driving, countless tales have grown up concerning him. They tell of his early boyhood and how, as a small tot, he wanted to be a steel driver and predicted that the Big Bend Tunnel was going to be the death of him. They tell of the life that he led, of his wanderings, and of his exploits, which have been so enlarged upon with the passing years that John Henry has become a legendary figure.

Sometime after John Henry's death, his ghost is said to have appeared in the tunnel and to have driven steel just as he had done in life. Upon hearing this, the Negro laborers, being by nature superstitious, were reluctant to enter the portals of the tunnel. The sounds which they heard, and which they thought came from steel striking steel, were later discovered to be water dripping from the roof of the tunnel and echoing and reëchoing in a very mysterious and uncanny fashion.

If some of the tales pertaining to John Henry have any foundation in fact, it must be admitted that he was something of a Jack-of-all-trades. At one time he is supposed to have had a job breaking up old iron. He would look over each new lot, according to accounts, and sit down and think about how best to make each blow count. Then he would go home and not do any work at all that day. The next morning, however, would find him hard at it, and before long the job would be finished. Pieces of iron 12 inches thick did not faze him, and it was a simple matter for him to break up big wheels and anchors, working by the job or by the ton.

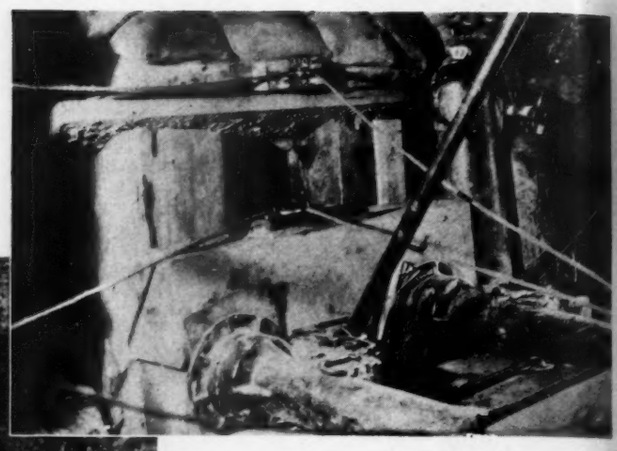
From another source we hear that John Henry was a blacksmith and that he learned his trade at a very early age in a Confederate arsenal. Subsequently, he became the body servant of Lieut. William Boyd of Whitehall, Va. In still other tales he is pictured as a seaman and as a railroadman, the latter probably explaining the following well-known verse:

Old John Henry was a railroadman,
Washed his face in a frying pan,
Combed his hair with a wagon wheel,
Died with a toothache in his heel.

As to his character, John Henry has been described both as a very bad man, who drank his whiskey straight and played cards till dawn, and as a good man who was a member of the Methodist Church and who was respected by his employers and his fellowmen. But good or bad, truth or fabrication, it matters not, because in John Henry we have another Baron Münchhausen whose doings will continue to delight all those that enjoy tall stories.

**After John Henry died, the workers imagined they heard his ghost driving steel in the tunnel and were reluctant to enter the bore.**

# Heavy Jacks Push 36-Inch Pipe Through Long Fill



**NEW AND OLD PIPE AND JACKING ABUTMENT**

**With the exception of the timber abutment (right), no trouble was experienced in jacking the 36-inch-diameter corrugated drainage pipe through the bottom of the 200-foot-wide fill. Work was carried on day and night, and was finished in eighteen days and fourteen hours at an average cost per foot of $24.51. This is much less than it would have been by trenching. In the picture above, the new pipe is at the left and the broken one at the right.**

COLLAPSE of a cast-iron drainage pipe under a much-traveled state highway near Pittsburgh, prompted the Pennsylvania Department of Highways to do some experimenting. The road at that point runs over a high fill, which has a width of 200 feet where the blocked conduit lies. To tear up the highway and dig a trench across it down to the same level not only would have involved heavy costs but would also have interfered considerably with traffic. It was therefore decided to drive the 36-inch replacement pipe through the ground with jacks, much as is now being done in the case of pipes of smaller diameter.

Not being equipped for work of this kind, the department purchased two 50-ton jacks each weighing 310 pounds and having a 24-inch lift. The latter was desirable so as to avoid frequent shifting of the blocking and fittings necessary to transmit the pressure exerted by the jacks to the pipe. These, together with a guide for the pipe and a jacking abutment, constituted the set-up for the undertaking.

The track consisted of two 12x12-inch timbers laid 18 inches apart and protected along the upper inside edges by 3x3x5/16-inch angles. This was laid on a grade of 2.9 per cent in conformity with that of the pipe, which was to be driven up to the chosen point on the other side of the fill. The abutment, which had to take the full thrust of the jacks, was an important item, and for this purpose a timber bulkhead was built. This, because of the marshy nature of the soil, had to be anchored to "dead men" by means of cables and further held down by sand bags piled on a superimposed platform.

As this was to be a 24-hour-a-day job, a shed was reared over the jacking equipment to protect the workmen from the weather, and a small gasoline-driven lighting plant with an extension line was provided to furnish the necessary illumination. Ventilation soon became a problem, and to clear the tunnel of the foul odor that apparently arose from decaying vegetation, the air compressor that had been installed to operate a clay digger was made to do double duty, and did so effectually.

The conduit is ⅛ inch thick and corrugated circumferentially. Except for the first two sections, which are 12 feet long, it is made up of 10-foot units. To lessen friction, there were riveted to them, top and bottom, slip plates with corrugations running lengthwise. The method of procedure was to excavate a 2-foot passage with an all-around clearance of 3 inches ahead of the pipe, to jack the latter forward, and then to resume digging.

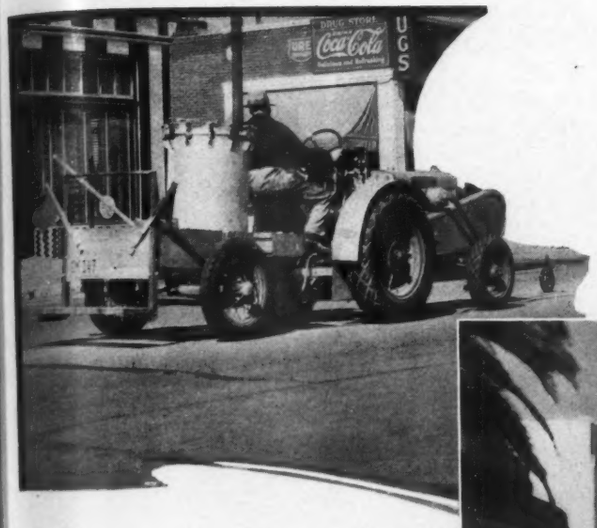
To steer the conduit in the right direction, two boards, measuring ½x3x36 inches, were hinged end to end so that they could be folded or opened at right angles at the mucker's convenience. In each board were a number of slits about 6 inches long. When properly placed with a carpenter's hand level, one arm of this contrivance was in a horizontal and the other in a vertical plane. In that position, the workman proceeded to hold his lamp behind each slit in succession, thus making the light visible to men on the outside where line and grade sights were set up clear of the excavation. If the line deviated from the prescribed course, more material was removed on the side toward which it needed to be directed so that it could be barred over. At frequent intervals, shallow trenches were dug across the bottom of the tunnel to prevent any loose dirt which might be carried along with the pipe from accumulating to such an extent as to interfere with jacking. Few large stones were encountered, the fill being largely a homogeneous mixture of clay and small stones or shale.

Initially, four miners were employed to do the excavating, two on each 12-hour shift. These alternately worked half an hour and rested half an hour. After the pipe had been advanced 100 feet, two more men were put on, one on each shift. In addition to the pneumatic clay digger, ordinary spades with cut-down handles and short-handled miners' picks were used. Labor at the jacks was divided into three shifts of eight hours each, with six men on each shift, or three to a jack.

From the time jacking started until the conduit appeared at the opposite side of the fill, eighteen days and fourteen hours of well-nigh uninterrupted work had elapsed, the average progress recorded being a little more than a 10-foot section a day. About two days were lost in resetting the jacking abutment which, because of the heavy character of the job, proved inadequate despite the precautions taken. In case of similar operations, it is suggested that a concrete abutment be used, or a crib filled with lean concrete. This could be designed as a part of the headwall and apron of the finished structure and kept low enough so as not to interfere with the flow of water after the conduit is in place.

The work was done at a total cost of approximately $5,000, and is the first of its kind ever to have been undertaken by the Pennsylvania Department of Highways.

# Modern Equipment for Painting Stripes on Highways



**THE HIGHWAY STRIPER**

**Front and side views of the machine in operation on a street in Hollywood, Calif. This equipment paints traffic-lane stripes at the rate of about 2 miles an hour, thereby not only reducing the cost but at the same time lessening interference with the normal use of the roadway.**

NOTABLE progress has been made in recent years in the development of equipment for painting traffic lines on city streets and rural highways. This work was originally done by hand, the procedure being to pour the paint from a container having a spray spout. That was obviously a laborious, slow, and expensive method, and various highway engineers set about to improve upon it.

One of the first requirements for speeding up the work was to provide some means that would cause the paint to issue at a faster rate from the spray head, and this led to the application of compressed air to secure the needed pressure. The first improvement upon the hand method was a wheelbarrowlike vehicle on which was mounted a small gasoline-engine-driven compressor, the paint container, and the spray equipment. The motive power was still manual.

This mechanism was followed by a tricycle type of vehicle which permitted carrying a greater quantity of paint and generally enlarged equipment. However, the process of putting down the stripes was still comparatively slow and expensive. In recent years the trend has been towards automotive vehicles, and these have taken various forms in the different states according to the individual ideas of the respective highway engineers.

The accompanying pictures show a modern apparatus that was designed not by a highway technologist but by a paint manufacturer. The latter believed that it would afford him an opportunity to sell more paint, and that has proved to be the case. The equipment belongs to J. E. Bauer of Los Angeles, Calif., who uses it on contracts to put down center lines and traffic marks for various municipalities in his section. The photographs that are reproduced here were taken on a street in Hollywood.

The outfit consists of a Silver King tractor and a trailer, both mounted on wheels with pneumatic tires. There is also a pilot wheel in front which enables the driver to follow the desired line. On the front of the tractor is an Ingersoll-Rand, 2-stage, air-cooled Type 30 compressor which is driven through V-belts from the power take-off of the tractor. The discharge line from the compressor is connected with a small receiver underneath the tractor, and from the receiver a line leads to the pressure paint tank, which is carried on the trailer, and one line to each of the two spray-gun heads. The line to the paint tank supplies the pressure necessary to force the paint to the spray-gun heads, and the lines to the spray-gun heads are for the purpose of atomizing or spraying the paint.

The spray-gun heads, which are of De Vilbiss manufacture, are mounted 7 or 8 inches above the road level and between the rear wheels of the tractor. Each is located between two vertical revolving disks about 16 inches in diameter and spaced about 4 inches apart. The paint spray issues between these disks, thus forming a 4-inch stripe. As there are two spray-gun heads and four disks, it is possible to paint either a single or a double line.

The machine is heavier and sturdier than most appliances of this sort, and has worked satisfactorily and without any trouble during the period of several months that it has been in service. Ordinarily, four or five men are assigned to work with it, and thus manned it can place about 2 miles of striping per hour.

# Atom Smasher

INDUSTRIAL engineers of the Westinghouse Electric & Manufacturing Company, in an effort to solve some of the mysteries surrounding the structure of matter, are preparing to bombard targets of various materials with submicroscopic particles shot from a gigantic "atom smasher" at a velocity of from 30,000,000 to 100,000,000 miles an hour, according to Dr. L. W. Chubb, director of the company's research laboratories.

The unique structure is now being built at East Pittsburgh, Pa., and constitutes the world's largest unit for conducting experiments in the field of nuclear physics. It consists of a pear-shaped tank, 47 feet high and 30 feet in maximum diameter, housing an electrostatic direct-current generator and other necessary equipment, including a 40-foot vacuum tube through which the particles will pass on their way to the targets.

Current generated in the atom smasher will reach a voltage of 5,000,000 and more and will serve to accelerate the streams of ions traveling down the long vacuum tube. On their way to the targets the particles will be counted, measured, and identified by special instruments developed for the purpose. From the end of the vacuum tube they will leap through thin windows of metal and strike the targets with velocities great enough to penetrate the hard centers or nuclei of the atoms and to produce new substances. The huge tank will be charged with air under a pressure of 120 pounds per square inch, and this will serve further to insulate the 5,000,000-volt electrostatic generator.

Commenting on the investigations, Dr. Chubb has said: "Physicists today are still learning about processes, energies and sequences of operations, which will give nuclear reactions and transmutations of one element into another. By constant experimenting they will learn how to duplicate nature's work, how to change elements, and how to create new products and processes.

"Comparatively recent discoveries have started a scientific revolution which we believe will have far-reaching results in discoveries of fundamental knowledge. Nearly all such knowledge gained has found practical application. Though we do not know where our present work will lead, or exactly what results we shall gain, we know that in this new field are hidden golden nuggets of scientific opportunity."

**ARTIST'S CONCEPTION OF THE TANK**

**In this huge laboratory, scientists will study the tiny atom in an attempt to solve some of the secrets surrounding the structure of matter. Including the building on which it rests, the structure will be 65 feet high. The drawing, showing the exterior of the tank and its associate features, is reproduced by courtesy of the Westinghouse Electric & Manufacturing Company.**

## Closed Scrubber System for Flue Gases

IN VIEW of the increasing opposition to the pollution of the atmosphere with flue gases and of waterways with waste from industrial plants, the washing process developed for the new Fulham power plant, situated in a thickly populated section of London, England, should be of interest. When completed, this 300,000-kw. station will consume daily 2,200 tons of coal containing from 0.75 to 1.5 per cent of sulphur. It was to remove the objectionable sulphur from the stack discharge that the closed liquor system was designed that at the same time takes care of the waste products incident to its operation.

By means of the Howden ICI scrubber system, close contact is established between the washing liquid and the flue gases by a combination rain and surface film action. To assure fairly complete absorption and neutralization of the $SO_2$ and other acid constituents, milk of lime is added to the water. This, together with $CO_2$ absorbed from the flue gases, produces insoluble chalk and calcium carbonate, which is soluble and constitutes the active absorbing and neutralizing agent. Fresh amounts of the latter are continually being formed from the chalk, and fresh milk of lime is fed into the system all the while to maintain the supply and to prevent the recirculating liquid from becoming acid.

The $SO_2$ and the $SO_3$ contained in the flue gases are absorbed by the washing liquid as calcium sulphite and calcium sulphate, and these relatively insoluble salts are precipitated when the saturation points are exceeded. This takes place in an especially designed part of the recirculating system.

# This and That

**One the Oldtimers Missed**

There is little placer ground remaining in the United States from which the hand-panner can derive a living, and nuggests of large size are now rarely found. These circumstances add interest to a report from Idaho that a prospector in the Prichard Creek area, near Murray, recently uncovered a lump of gold worth $540. He made the find by driving a short drift into an isolated bank of gravel that was left by operators who dredged the creek bed more than 50 years ago.

★ ★ ★

**A Gold Mining Romance**

Some two years ago, two prospectors, "Red" Staggs and Clyde Taylor, discovered a gold deposit in Humboldt County, Nevada. George Austin, operator of a trading station and hotel in the Town of Jungo and a veteran gold seeker, gave them $10,000 for their claims. Austin began working the property in a small way, and from time to time reports of its richness got into the papers. These accounts persisted to the point where established mining companies sent representatives to investigate. Austin showed them enough to convince them that a good mine was in the making, and offers to purchase began to be showered upon him. He refused them all. Finally, former President Herbert Hoover examined the mine and became so enthusiastic over its prospects that he attempted to buy it. Still the owner was not disposed to sell, whereupon Mr. Hoover told him that he had a fortune in his grasp and advised him never to part with the property. Now, however, Austin, past 60 and always comparatively poor, has ignored that counsel. Three wealthy Texans have secured an option on the mine for a down payment of $250,000, and have contracted to operate it under an agreement to pay Austin or his family a minimum of $100,000 a year. In the event the option to purchase is exercised, then the seller is to receive a total of $10,000,000 at the rate of $1,000,000 a year.

★ ★ ★

**Fashions in Horse Collars**

Some one interested in animal welfare has recently devised a collar for horses that will not scuff nor chafe their necks. In appearance, it is like the conventional collar, but contains a special rubber tube that is inflated with air at about 5 pounds pressure. This renders the collar so flexible that it is claimed a hand can be slipped between it and the horse's shoulder even when a full load is being pulled. Air is introduced through a valve at the lower end of the collar.

★ ★ ★

**Boulder Dam Elevators**

Employees of the Boulder Dam power plant have one thing in common with persons who work in New York skyscrapers: in both cases they are carried to and from their places of business by elevators. But there is an important difference. New Yorkers enter at the street level and are whisked upward from one to 80 or 90 stories, depending upon the building, while at Boulder Dam employees step into the elevator at the top of the dam and are lowered 528 feet to a gallery leading to the power house.

The uppermost landing at Boulder Dam is at elevation 1,232.82, and the lowest is at elevation 704.6. There are four intermediate landings that give access to inspection galleries in the dam. The lift has a capacity of 5,000 pounds and a speed of 500 feet per minute. The trip from top to bottom takes one minute and three seconds. Besides serving the employees, it is used by an average of 700 visitors daily and has transported as many as 3,741 persons down and back in a 15-hour period. In addition to this main elevator, there are two other lifts in the power house proper and two more in the canyon walls that give access to the outlet works on each side of the river.

**"He's from the West."**

**64 Years With One Concern**

William W. Hanold, who died recently in Brooklyn, left a record that few men can ever equal. He spent 64 years in the employ of one firm, Johns-Manville and its predecessor companies. When he was thirteen, he answered a newspaper advertisement inserted by H. W. Johns, who was then running a 4-man establishment in New York. Mr. Johns was experimenting with asbestos. He made roofing paper by pouring tar on heavy paper, sprinkling it with asbestos fibers, and running it through a clothes wringer. His foremost sales argument was that asbestos would resist fire. But customers were skeptical, so it was young Hanold's duty to show them. Donning a glove made from asbestos, he would thrust his hand into the heating stove and stir the coals around. The demonstration was always effective, and to it can be attributed in some measure the successful launching of the huge corporation that now holds a dominant position in the asbestos-products field. Subsequently, Mr. Hanold held many posts with the firm. His last years were spent as librarian, where his vast knowledge of the company's products made him virtually a walking encyclopedia. He was offered retirement many times, but refused it on the grounds that the boredom of idleness would kill him.

★ ★ ★

**Simple Test for Gold**

The Canadian Institute of Mining and Metallurgy has published directions for making a simple field test for gold by which prospectors can determine whether their samples contain values of $2 or more per ton. By the use of this method they can get a rough idea of what their discoveries are worth without the delay and expense of having the ore assayed. In making the test, approximately 2 pounds of the mineral-bearing rock is crushed as fine as possible, and the powder is panned to concentrate its heavier constituents. As much of this concentrate as can be picked up on a 25-cent piece is then placed in a test tube which has been one-third filled with a 10-per-cent solution of iodine. This is heated about ten minutes, but not allowed to boil, and is then set aside until the liquid becomes clear. With an eye dropper, the solution is next transferred to a hot watch crystal and allowed to evaporate, drop by drop. If the gold content of the ore has a value of $2 or more per ton, a gold mirror will be formed on the glass. The cost of the equipment required is less than $5.00.

### THE MEXICAN NILE

LA LAGUNA District in Mexico, which lies about 700 miles south of the United States border, produces more cotton per acre in some years than any other area on earth. The years in which it does this are those in which the Nazas River overflows its banks and spreads a rich deposit of silt over the land, just as the Nile does in Egypt. But it is the nature of things that three years out of five the Nazas does not overflow. In such years, of which this is one, the cotton crop falls to from 65,000 to 90,000 bales, as compared with the 150,000 bales that can be counted on when the river is swelled to abnormal proportions.

La Laguna comprises about 900,000 acres of land, of which 250,000 acres is cultivable. It has been raising cotton, as well as wheat, for 50 years. It was developed by Englishmen and Spaniards, who constructed an elaborate system of sluices and pumps to distribute the loam-bearing flood waters over the fields. Until last year it consisted of a small number of large estates. Then the government expropriated these holdings and divided them among the peasants. It set up a communal farming system under which the proceeds from the crops are divided among the farmers on a basis of each one's yield.

Now the Mexican Government is going a step further. In an effort to regulate the flow of the Nazas River, and, consequently, to make a profitable flood possible every year instead of intermittently, it is constructing a huge earth dam. That structure will play the same rôle as does the Assuan Dam in Egypt, equalizing the stream flow and impounding water that can be released down-stream at will.

This is the most ambitious undertaking of its kind ever fostered by the Mexican authorities. It may be the forerunner of many other schemes to conserve and to control the water resources of the nation so as to increase agricultural productivity. Millions of dollars are being expended in the construction of La Laguna Dam. which is rising with the aid of modern machinery and the labor of 1,000 men. The dam will extend between two flanking hillsides approximately 1,000 feet apart. It will be 235 feet high and more than 1,650 feet thick at the base. In point of material contained, it will be one of the largest, if not the largest earth-filled dam in existence It will create a lake having a capacity of more than 200,000 acre-feet of water. In future issues we will describe this important project in greater detail.

### GERMANY'S NEW HIGHWAYS

WE HAVE previously referred here to the network of arterial motor highways now being constructed in Germany. Known as *Autobahnen*, and restricted to the use of automotive vehicles, they represent the first effort of any country to build a system of unified, high-standard roadways. Up to July 1 of this year, 860 miles had been completed, and work was progressing on some 2,000 miles of additional routes.

These highways are designed for speeds up to 110 miles an hour in flat country and up to 80 miles an hour in mountainous sections. The curvature is controlled so as to afford vision for sufficient distances to make for safe driving at the specified maximum speeds. The same provisions have been made with respect to grades on either side of rises. The standard has been varied somewhat according to the region traversed and there are three general classfications: lowland, hilly, and mountainous roads. In all cases, however, the standard is high, as judged by prevailing engineering practices elsewhere in the world.

Regardless of the class, all the *Autobahnen* call for two 1-way traffic lanes each 24 feet wide and separated by a green strip ranging from 11½ to 17½ feet wide. To eliminate headlight glare, hedges are being planted in the central strip. Each traffic lane is built of concrete, which normally is 8½ inches thick but is increased to nearly 10 inches in fill sections or where the sub grade is not all that is desired. Flanking the inside edge of each concrete strip is a marginal strip of bitumen-surfaced roadway 16 inches wide, while on the outside edge there is a similar border 40 inches wide. These dark surfaces contrast sharply with the lighter-colored concrete and serve to delineate the driving surface clearly Maximum grades range from 4 per cent in the lowlands to 8 per cent in the mountains.

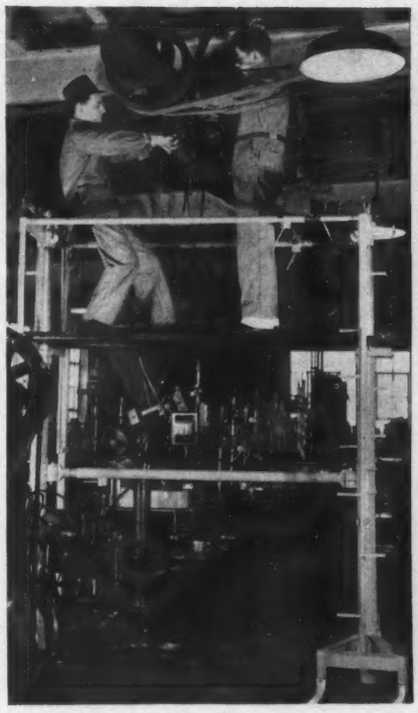
Few of the existing country roads will be joined with the *Autobahn* system. Where such access is provided, approaches run parallel with the main highway for considerable distances to permit vehicles entering the arterial roadway to gain speed before joining the fast-moving traffic. Similar provisions permit cars to leave the main highway without slackening speed until they are out of the traffic line. At junctions and crossings of the *Autobahn* routes, the structural design has been carefully worked out to promote safety and to avoid excessive slowing down of motorists because of the converging or diverging traffic streams.

The *Autobahn* project was formulated by the government in 1933 as a means of alleviating unemployment, of increasing the purchasing power of the laboring class, and of stimulating the business of concerns supplying materials and equipment for roadbuilding. The Reich maintains general control over the scheme, which is being financed largely by taxation and credit extended by the Reichsbank; but it is interesting to note that a community of interest has been given the German Railway Company, which stands to be the principal loser of revenue when the network is completed. The railroad was permitted to organize a subsidiary company, known as the Reichsautobahnen, which has been given the monopoly of constructing and managing the road system and of erecting and operating the appurtenant structures such as filling stations, garages, restaurants, and hotels, all of which are expected to prove profitable enterprises.

## Traveling Elevator with Platform Control

MOBILITY, flexibility, and one-man control are the outstanding features of a new scaffold that has been designed for general industrial and other service. It is a combination scaffold, ladder, and workbench that is demountable, can be raised and lowered under its own power to any level within its limits, and can be moved from one position to another without assistance from the outside.

The Decovator, as it is designated, comes in two sizes. It is built of steel throughout, and its platform, protected by railing, is mounted on standards that are hydraulic lifts. These give the platform an elevation of 13 feet 4 inches in the one case and of 18 feet 10 inches in the other, enabling workmen to reach comfortably a height of 16 feet and of 22 feet, respectively, as the smaller scaffold is 2 feet 8 inches from the ground when in its lowest position and the larger one 3 feet 2 inches. From his station on the platform, a painter, repairman, or the like, can elevate the scaffold at the rate of 8 feet a minute and lower it at the rate of 10 feet a minute, as well as jockey it in any direction at a speed of 50 feet a minute. This unique traveling elevator is manufactured by the Decovator Scaffolding Corporation.



## Glaze-Raise—A New Concrete Building Material

CONCRETE with a glazed, raised surface is the newest development in building materials that, if all the claims made for it are true, will be of considerable interest to architects, builders, and contractors. It is a patented product which has been given the name of Glaze-Raise to distinguish it from ordinary glazed concrete with a plain face that has been known to the trade for some years. The material is being manufactured on a commercial scale in London, England.

Glaze-Raise is made by a process that gives the concrete a tool-raised finish with a luster equal to that of plate glass or the best grade of tiling. A mat or a sand-blast finish, or a combination of all three, can also be produced, as well as an unlimited range of designs and color effects both plain and variegated. This makes it possible to reproduce marble, for example, the imitations in some cases being so good that even experts have not been able to pick out the natural stones.

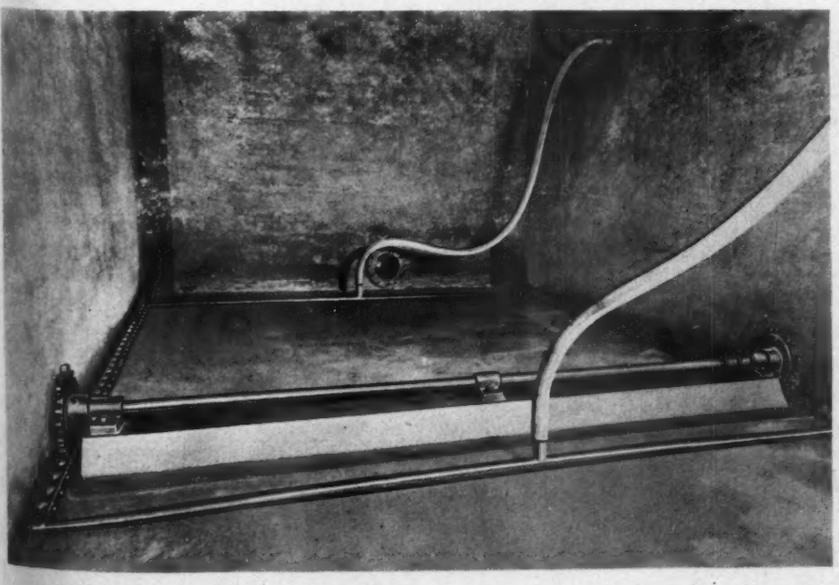
According to the available information from a Canadian source, the material requires nothing new in the way of machinery for its manufacture, that being used for ordinary concrete being suitable for the purpose. Furthermore, unskilled labor can soon be taught to do the work. This makes for low production costs. The necessary plant can be put in readiness for operation in about six weeks, and should be located where it will not be affected by vibration set up by heavy traffic. Sheets up to 6 feet long can be turned out, permitting quick laying.

Tests have proved Glaze-Raise to be well-nigh indestructible. These included exposing specimens to extremely low and high temperatures—2,200°F. in an electric furnace—to determine the durability and quality of the finish. No signs of crazing or cracking were evident; nor did the application of sulphuric acid change the appearance of the glaze.

As summed up by the manufacturer, the material is weatherproof, fireproof, crackproof, and washable, and can be used to advantage either indoors or outdoors wherever tiling is now specified—in hospitals, laboratories, bathrooms, swimming pools, kitchens, for store fronts, table tops, hearths, etc.

## Vacuum Sludge Remover for Rectangular Tanks

A VACUUM system of sludge removal for rectangular settling tanks of varying dimensions has been developed by the Chain Belt Company of Milwaukee, Wis. It is said to be a marked improvement over mechanical scraping, as generally employed, and is being used to advantage in waterworks for the disposal of accumulations of algae and in sulphate-process pulp and paper mills for reclaiming wood fiber—paper stock—from white water.



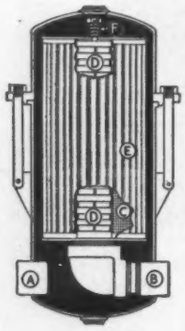
The suction unit consists mainly of two parallel pipes or nozzles disposed crosswise on the bottom of a tank and perforated on their undersides, and of flexible hose and outlet pipes connecting them with vacuum pumps on the outside. As our illustration shows, the nozzles are attached to the ends of roller racks—one on each side of the tank—and are moved back and forth by means of a central shaft provided with sprocket wheels which engage the roller racks. The shaft is driven through gears by an electric motor and is automatically reversed by means of a limit switch. Once set in motion, the operation is continuous, the nozzles, together, covering the entire floor each time the roller racks travel from one end of their course to the other. Two launders—the feed inlet and clear-water outlet—with a baffle in between to distribute the solids that settle in the areas covered by the two suction pipes, complete the equipment.

# Industrial Notes

Steel wool is now available in the form of rope for use in connection with floor-scrubbing or rotary-head sanding machines.

It has been found that sheet aluminum is suitable for packing butter, especially when it is to be held in storage, because that metal protects it from the harmful effects of light and air.

Protectomotor filters, which need no introduction, have a new member—Model CPHL. This is a lubricating line filter for the use of diesel and other internal-combustion engines. It is of substantially the same design as the Staynew Filter Corporation's air filter, and embodies the radial fin construction which assures an active filtering area of 1,325 square inches within the relatively small space of 11x8¼ inches. In the accompanying longitudinal section, which shows the structural features of a liquid-line filter designed for high-pressure service, *A* and *B* are the inlet and outlet, respectively; *C*, wire-mesh frame of the radial fin construction; *D*, reinforced core; *E*, filter insert; *F*, retaining spring. The low-pressure unit is much the same, only the core and spring are missing. Models and sizes are available for well-nigh unlimited capacities and pressures—the one illustrated being designed for a pressure of 125 pounds. Generally arranged for use in connection with horizontal lines, the new Protectomotor oil filter can be quickly inspected, drained, and cleaned. For the latter purpose it is necessary only to remove the filter insert, to dip it in gasoline, and to scrub it with a soft brush, using a spare in the meantime.




To take inside measurements of holes or recesses, Brown & Sharpe Manufacturing Company has designed an instrument that is a combination micrometer and gauge. It is provided with eight telescoping rods having a measuring range of 2 to 6 inches in thousandths of an inch. It is listed as Micrometer No. 268 and costs $20.75, including the case.

According to the U. S. Bureau of Public Roads, the use of vibrators when pouring concrete pavements makes the latter 10 per cent stronger than they otherwise would be. The bureau conducted exhaustive tests to determine the effect of vibration on concrete and has recently published a report on its findings.

Truck drivers who spend most of their time on the road can be made more comfortable, we are informed, at trifling expense by the use of a little insulating material. A sheet of Celotex under the top and another under the floor boards will do much to keep out the sun's rays and the heat of the engine.

Fisher Scientific Company has developed a piece of laboratory equipment for determining the melting point of solids up to 570°F. It consists of a 2-inch-diameter electrically heated stage, a magnifying glass, a thermometer, and a stepless transformer, together with the necessary wiring for 110-volt alternating current or, upon request, for 220-volt current. The apparatus can also be used as a hot plate for small-sized beakers.

It has been reported from London that Eldorado Gold Mines, Ltd., because of the scale on which it is operating, has been the means of cutting the world price of radium in half. In view of its estimated pitchblende reserves and the increasing demand for this radioactive element, the company has decided to treble the capacity of its plant at Port Hope, Canada. The radium bromide produced there is exceptionally free from mesothorium, and is sent to England for measurement of its radioactivity.

As a further aid to machine operators, the General Electric Company has developed a push-button station with an indicating lamp in the center of the translucent button. This makes for a compact unit that takes up only about half the space required when the two are mounted separately. It is 2⅝ inches high, 1¼ inches wide, and 2⅝ inches thick, and is available with a white, green, blue, red, clear, or amber button. The lamp is operated through a diminutive transformer which can be readily installed in or on any machine.

Converting the enormous volumes of natural gas that are now wasted annually into products of far greater monetary value is the fascinating picture presented to us by Dr. E. P. Schoch, director of the Bureau of Industrial Chemistry of the University of Texas. Doctor Schoch has discovered a method of processing natural gas into by-products such as carbon black and acetylene right at the well, if desired. Patent has been applied for, and when granted, it is Doctor Schoch's intention to present it to the State of Texas where $200,000,000 worth of natural gas goes to waste each year.

With the fact established that heat sickness and prostration can be largely prevented by restoring to the human body the salt carried away with perspiration, it is becoming the practice to give men working in the sun or otherwise exposed to great heat doses of sodium chloride to make up the deficiency. It is now being put up in tablet form for that purpose, one firm offering them under the name of Heat-beaters in containers which are arranged to dispense them one by one. Each container holds 3,000 ten-grain tablets and costs $1.75.

The Garlock Packing Company is celebrating its fiftieth anniversary this year, and is pointing with pride to the fact that its main factory is situated in Palmyra, N. Y., where the firm originated. The first packings which led to the founding of the company in 1887 were rings cut from old rubber hose. It was from this modest beginning and a few workers that the company has grown to its present proportions requiring the services of more than 1,000 people, including the representatives maintained in all the principal cities in the United States. Of the five plants now turning out hundreds of Garlock products one is located in Canada.

E. D. Bullard Company has announced a new style in miners' hats. It is called the Tuff-Nutt, and is said to weigh 10 per cent less and to offer greater protection and comfort than any other hard-boiled headgear on the market. It is molded in one piece and has an all-around air space between the crown and the sweatband. The latter is made of a transparent material that feels cool, does not absorb perspiration and dirt, and can be easily cleaned. Four snapfasteners hold it in place. By putting a number of these bands in a hat it is possible to vary the fit. This is an advantage, because it obviates carrying a large stock of different head sizes. There are three models: the Shorty, which has a short brim front and back; the Drifter, with a short front and side brim and a wide brim in back; and the Cap. They are olive green in color and weather resistant.

A revised edition of *Engineering Properties of K Monel* has been published by The International Nickel Company, Inc., 67 Wall Street, New York, N. Y. It contains the latest data on the strength, hardness, and other mechanical properties obtainable with that metal, instructions for heat-treating it, notes on shop working procedures, etc. Anyone interested can get a copy upon request.

## Petroleum Production Gains

THE production of petroleum in the United States continues to rise, and, despite the fact that it is now running nearly 8 per cent higher than the needs of the country, as calculated by the Bureau of Mines, no great fear is felt that the surplus is reaching serious proportions. A stabilizing influence is the steady gain being registered in the use of petroleum products. Most pronounced among the factors that contribute to this acceleration is the continued increase in the number of automobiles in service.

Recent figures from the American Petroleum Institute indicate that by the end of the year there will be 30,000,000 registered motor vehicles in the country, of which 25,000,000 will be passenger cars. This will represent a new high mark and an increment of approximately 4,000,000 cars over 1935. The fact that this record registration will be attained in the beginning of the year rather than during the warm-weather season is significant, showing, as it does, a trend towards increased winter driving. This is the result of two developments: first, improvement in the cars themselves, and, second, greater effectiveness by highway-maintenance agencies in keeping roads open for travel. Heaters, windshield defrosters, and other accessories have made the modern closed automobile more comfortable and safer for winter use, while snow-removal activities of the states and counties are doing away with the uncertainties, dangers, and discomforts that formerly were associated with driving in the cold-weather months.

A third stimulus to winter motor travel is the growing practice among the states to defer payment for license plates for varying periods. In states that demand payment at the beginning of the year, as many as 25 per cent of the cars are temporarily withdrawn from service and owners wait until late in the year to take advantage of lower fees. Having recognized this, about two-thirds of the states now grant from one to three months grace for renewal of annual registrations.

Concurrent with the greater use of automobiles is an increased demand for heating units, diesel engines, and other types of equipment that burn heavy oils.

The petroleum output is now exceeding 3,700,000 barrels a day. More than 1,500,000 barrels come from Texas. Refineries are operating at more than 85 per cent of their capacities, but stocks of motor fuels are not excessive and are not increasing appreciably.

An interesting sidelight on petroleum production is the fact that 15 per cent of the nation's oil wells yield 85 per cent of the daily output. The other 85 per cent each produce from one-quarter barrel to 5 barrels a day. Although some are more than 60 years old, no major oil field of the country has yet become exhausted.

Dangerous

**IF THEY ESCAPE...**

**yet safe as the water in a glass!**

IT'S NO TRICK for a glass to hold water without letting any of it seep through. But it's quite a trick to make steel castings so faultless that the dangerously searching substances encountered in the oil industry can't seep through.

The tiniest of flaws is a wide open escape door for compounds like butane ($C_4H_{10}$), propane ($C_3H_8$), methane ($CH_4$). They worm their way through imperfections that can be seen only under a powerful microscope. It's the sheer flawlessness of Lebanon Circle L Castings that keeps these compounds safely confined. Lebanon Circle L Castings are rendering distinguished service in oil field drilling, in refineries and in pipe lines—in every branch of the oil industry.

**SEAL THE PROFIT GAPS!** Profits, too, can escape through unnoticed flaws. Destructive chemical actions, high pressures, corrosion and wear do not limit themselves to the oil industry. In your own plant there may be "flaws" through which profits seep away. Call in a Lebanon expert to help you check up.

*Oil Men!*

**Visit the Lebanon Booth at the Houston Show — October 11-16**

**LEBANON STEEL FOUNDRY**

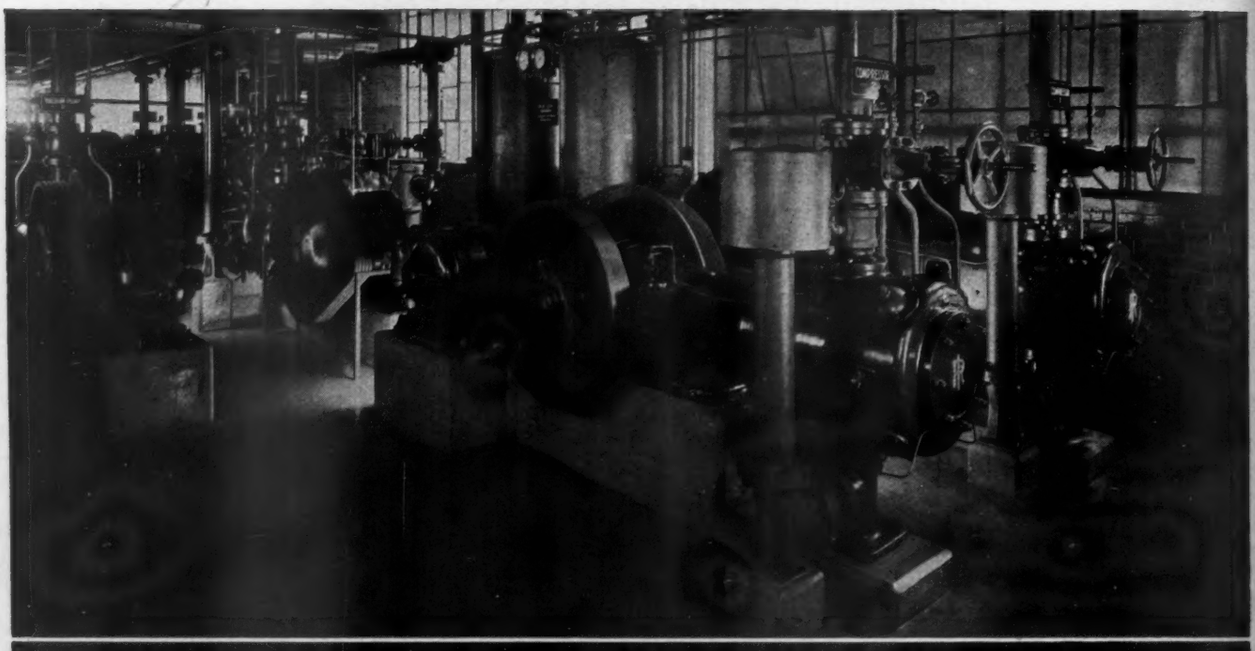
EXCLUSIVE AMERICAN LICENSEE FOR GEORGE FISCHER METHOD SCHAFFHAUSEN, SWITZERLAND

CIRCLE L

**LEBANON, PENNA.**

*Stainless and Special Alloy Steel Castings*

# AMERICAN HAMMERED PISTON RINGS



## SERVICE RECORDS ARE MADE IN THE FIELD . . . . . BUT START IN THE LABORATORY

Industry's constantly increasing and varied use of compressed air has made the manufacture of compressors a highly specialized business. Piston rings play a vital part in proper compressor performance. To meet their responsibilities, they too must be specialized.

American Hammered Piston Rings are designed specifically for their job. The illustrations at the right suggest how far this specialization goes. Results are apparent wherever compressors equipped with American Hammered Piston Rings are in operation.

**KOPPERS COMPANY**
**AMERICAN HAMMERED PISTON RING DIVISION**
**Baltimore, Md.**

The alloy which makes maximum ring service possible in compressors has a graphite structure of the type shown in this photomicrograph.

Note the difference in this alloy . . . which is used for high-speed service, such as aircraft, diesel, and similar applications . . .

and this . . . which goes into rings for steam, and for other heavy-duty applications. Each of these alloys is selected for its specific job.

Because our tests indicated, and experience has proven, that only a series of alloys can offer the individual properties that will properly solve piston ring problems, American Hammered Piston Ring *starts* specialization in the laboratory.

## KOPPERS COMPANY

DESIGNERS . . . BUILDERS . . . PRODUCERS . . . MANUFACTURERS . . . DISTRIBUTORS . . . OPERATORS